



Certificate #4312.01

TEST REPORT

Product Name: Dual-Band Wi-Fi Router
Trade Mark: GRANDSTREAM
Model No. / HVIN: GWN7052
Report Number: 220322031RFC-2
Test Standards: FCC 47 CFR Part 15 Subpart E
RSS-247 Issue 2
RSS-Gen Issue 5
FCC ID: YZZGWN7052
IC: 11964A-GWN7052
Test Result: PASS
Date of Issue: June 6, 2022

Prepared for:

Grandstream Networks, Inc.
126 Brookline Ave., 3rd Floor Boston, MA 02215, USA

Prepared by:

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June 6, 2022

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Version

Version No.	Date	Description
V1.0	June 6, 2022	Original



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CONTENTS

1. GENERAL INFORMATION	4
1.1 CLIENT INFORMATION	4
1.2 EUT INFORMATION	4
1.2.1 GENERAL DESCRIPTION OF EUT	4
1.2.2 DESCRIPTION OF ACCESSORIES	4
1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD	5
1.4 OTHER INFORMATION	6
1.5 DESCRIPTION OF SUPPORT UNITS	7
1.6 TEST LOCATION	7
1.7 TEST FACILITY	7
1.8 DEVIATION FROM STANDARDS	8
1.9 ABNORMALITIES FROM STANDARD CONDITIONS	8
1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER	8
1.11 MEASUREMENT UNCERTAINTY	8
2. TEST SUMMARY	9
3. EQUIPMENT LIST	10
4. TEST CONFIGURATION	11
4.1 ENVIRONMENTAL CONDITIONS FOR TESTING	11
4.1.1 NORMAL OR EXTREME TEST CONDITIONS	11
4.1.2 RECORD OF NORMAL ENVIRONMENT AND TEST SAMPLE	11
4.2 TEST CHANNELS	12
4.3 EUT TEST STATUS	12
4.4 PRE-SCAN	13
4.5 TEST SETUP	14
4.5.1 FOR RADIATED EMISSIONS TEST SETUP	14
4.5.2 FOR CONDUCTED EMISSIONS TEST SETUP	15
4.5.3 FOR CONDUCTED RF TEST SETUP	16
4.6 SYSTEM TEST CONFIGURATION	17
4.7 DUTY CYCLE	18
5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION	22
5.1 REFERENCE DOCUMENTS FOR TESTING	22
5.2 ANTENNA REQUIREMENT	22
5.3 26 dB BANDWIDTH & OCCUPIED BANDWIDTH	23
5.4 6 dB BANDWIDTH & OCCUPIED BANDWIDTH	41
5.5 MAXIMUM CONDUCTED OUTPUT POWER OR E.I.R.P	53
5.6 PEAK POWER SPECTRAL DENSITY	63
5.7 RADIATED EMISSIONS AND BAND EDGE MEASUREMENT	98
5.8 AC POWER LINE CONDUCTED EMISSION	148
APPENDIX 1 PHOTOS OF TEST SETUP	151
APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS	151

1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

Applicant:	Grandstream Networks, Inc.
Address of Applicant:	126 Brookline Ave., 3rd Floor Boston, MA 02215, USA
Manufacturer:	Grandstream Networks, Inc.
Address of Manufacturer:	126 Brookline Ave., 3rd Floor Boston, MA 02215, USA

1.2 EUT INFORMATION

1.2.1 General Description of EUT

Product Name:	Dual-Band Wi-Fi Router		
Model No. / HVIN:	GWN7052		
Trade Mark:	GRANDSTREAM		
DUT Stage:	Identical Prototype		
EUT Supports Function: (Provided by the customer)	2.4 GHz ISM Band:	IEEE 802.11b/g/n	
	5 GHz U-NII Bands:	5 150 MHz to 5 250 MHz	IEEE 802.11a/n/ac
		5 250 MHz to 5 350 MHz	IEEE 802.11a/n/ac
		5 470 MHz to 5 725 MHz	IEEE 802.11a/n/ac
		5 725 MHz to 5 850 MHz	IEEE 802.11a/n/ac
Sample Received Date:	March 25, 2022		
Sample Tested Date:	March 25, 2022 to May 17, 2022		

Remark: The above EUT's information was provided by customer. Please refer to the specifications or user's manual for more detailed description.

1.2.2 Description of Accessories

Adapter1	
Model No.:	F12US1200100A
Input:	100-240 V~50/60 Hz 0.5A Max
Output:	12.0 V $\equiv$ 1.0 A
DC Cable:	2.5 Meter, Unshielded without ferrite

Adapter2	
Model No.:	DSA-12PFU-12 FUS 120100
Input:	100-240 V~50/60 Hz 0.5A
Output:	12.0 V $\equiv$ 1.0 A 12.0W
DC Cable:	2.5 Meter, Unshielded without ferrite

Cable	
Description:	Ethernet cable
Cable Type:	Unshielded without ferrite
Length:	1.5 Meter

Remark: The above EUT's information was provided by customer. Please refer to the specifications or user's manual for more detailed description.

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1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Frequency Bands:	5150 MHz to 5250 MHz (U-NII-1)	
	5250 MHz to 5350 MHz (U-NII-2A)	
	5470 MHz to 5725 MHz (U-NII-2C)	
	5 725 MHz to 5 850 MHz (U-NII-3)	
Frequency Ranges:	5180 MHz to 5240 MHz	
	5260 MHz to 5320 MHz	
	5500 MHz to 5700 MHz	
	5 745 MHz to 5 825 MHz	
Support Standards:	IEEE 802.11a/n/ac	
TPC Function:	Not Support	
DFS Operational mode:	Master	
Type of Modulation:	IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK)	
	IEEE 802.11n: OFDM(64QAM, 16QAM, QPSK, BPSK)	
	IEEE 802.11ac: OFDM(256QAM, 64QAM, 16QAM, QPSK, BPSK)	
Channel Spacing:	IEEE 802.11a/n-HT20/ac-VHT20: 20 MHz	
	IEEE 802.11n-HT40/ac-VHT40: 40 MHz	
	IEEE 802.11ac-VHT80: 80 MHz	
Data Rat Data Rate:	IEEE 802.11a: Up to 54 Mbps	
	IEEE 802.11n-HT20: Up to MCS15	
	IEEE 802.11n-HT40: Up to MCS15	
	IEEE 802.11ac-VHT20: Up to MCS8	
	IEEE 802.11ac-VHT40: Up to MCS9	
	IEEE 802.11ac-VHT80: Up to MCS9	
Number of Channels:	5150 MHz to 5250 MHz: 4 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40/ac-VHT40 1 for IEEE 802.11acVHT80	
	5250 MHz to 5350 MHz: 4 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40/ac-VHT40 1 for IEEE 802.11acVHT80	
	5470 MHz to 5725 MHz: 11 for IEEE 802.11a/n-HT20/ac-VHT20 5 for IEEE 802.11n-HT40/ac-VHT40 2 for IEEE 802.11ac-VHT80	
	5725 MHz to 5850 MHz: 5 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40/ac-VHT40 1 for IEEE 802.11ac-VHT80	
Antenna Type:	Chain 0	External Antenna
	Chain 1	External Antenna
Antenna Gain: (Provided by the customer)	Chain 0	5150 MHz to 5250 MHz: 5.0dBi
		5250 MHz to 5350 MHz: 5.0dBi
		5470 MHz to 5725 MHz: 5.0dBi
		5725 MHz to 5850 MHz: 5.0dBi
	Chain 1	5150 MHz to 5250 MHz: 5.0dBi
		5250 MHz to 5350 MHz: 5.0dBi

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		5470 MHz to 5725 MHz: 5.0dBi			
		5725 MHz to 5850 MHz: 5.0dBi			
Maximum EIRP (dBm):	SISO_Chain 0	U-NII-1			
	IEEE 802.11a:	18.39			
	SISO_Chain 1	U-NII-1			
	IEEE 802.11a:	17.16			
	MIMO_Chain 0+1	U-NII-1			
	IEEE 802.11n-HT20:	15.88			
	IEEE 802.11n-HT40:	19.83			
	IEEE 802.11ac-VHT20:	15.96			
	IEEE 802.11ac-VHT40:	20.06			
	IEEE 802.11ac-VHT80:	20.55			
Maximum conducted output power (dBm):	SISO_Chain 0	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
	IEEE 802.11a:	19.05	19.20	16.52	19.85
	SISO_Chain 1	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
	IEEE 802.11a:	17.82	17.41	14.59	18.22
	MIMO_Chain 0+1	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
	IEEE 802.11n-HT20:	19.15	16.55	16.24	21.21
	IEEE 802.11n-HT40:	18.24	18.03	16.73	21.20
	IEEE 802.11ac-VHT20:	19.33	16.78	16.42	21.43
	IEEE 802.11ac-VHT40:	18.47	18.23	16.99	21.39
	IEEE 802.11ac-VHT80:	15.55	15.46	13.64	21.21
Normal Test Voltage:		12 Vdc			

1.4 OTHER INFORMATION

Operation Frequency Each of Channel				
	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
IEEE 802.11a, IEEE 802.11n-HT20, IEEE 802.11ac-VHT20	$f = 5000 + 5k, k = 32 + 4n$			$f = 5000 + 5k, k = 145 + 4n$
	$n = 1, \dots, 4$	$n = 5, \dots, 8$	$n = 17, \dots, 27$	$n = 1, \dots, 5$
IEEE 802.11n-HT40, IEEE 802.11ac-VHT40	$f = 5000 + 5k, k = 30 + 8n$			$f = 5000 + 5k, k = 143 + 8n$
	$n = 1, 2$	$n = 1, \dots, 5$	$n = 9, \dots, 13$	$n = 1, 2$
IEEE 802.11ac-VHT80	$f = 5000 + 5k, k = 26 + 16n$			$f = 5000 + 5k, k = 155$
	$n = 1$	$n = 1, 2$	$n = 5, 6$	
Note: f is the operating frequency (MHz); k is the operating channel.				

1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

1) Support Equipment

Description	Manufacturer	Model No.	Serial Number	Supplied by
Notebook	Lenovo	Lenovo B40-80	MP12NEQ6	UnionTrust
Notebook	Lenovo	TP00067A	PN-0FZDEU 16\02	UnionTrust
USB disk	Kingston	DTSE9	N/A	UnionTrust
Mouse	DELL	MS111	CN-011D3V-738	UnionTrust
Mobile Phone	MI	MDG1	461cceef7d24	UnionTrust
Notebook	DELL	Latitude 3400	16238087894	UnionTrust

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Ethernet Cable	RJ45	1.5 Unshielded without ferrite	UnionTrust
2	Ethernet Cable	RJ45	2.0 Unshielded without ferrite	UnionTrust
3	Antenna Cable	SMA	0.1 Meter	UnionTrust

1.6 TEST LOCATION

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1.7 TEST FACILITY

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L9069

The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

A2LA-Lab Certificate No.: 4312.01

Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

ISED Wireless Device Testing Laboratories

CAB identifier: CN0032

FCC Accredited Lab.

Designation Number: CN1194

Test Firm Registration Number: 259480

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UTTR-RF-RSS247-V1.1

1.8 DEVIATION FROM STANDARDS

None.

1.9 ABNORMALITIES FROM STANDARD CONDITIONS

None.

1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

1.11 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

No.	Item	Measurement Uncertainty
1	Conducted emission 9KHz-150KHz	±3.2 dB
2	Conducted emission 150KHz-30MHz	±2.7 dB
3	Radiated emission 9KHz-30MHz	± 4.7 dB
4	Radiated emission 30MHz-1GHz	± 4.9 dB
5	Radiated emission 1GHz-18GHz	± 4.8 dB
6	Radiated emission 18GHz-26GHz	± 5.1 dB
7	Radiated emission 26GHz-40GHz	± 5.1 dB
8	Conducted spurious emissions	± 2.7 dB
9	RF Power, Conducted	± 0.68 dB
10	Occupied Bandwidth	± 1.86 %
11	Radio Frequency	5.6 GHz: ± 6.4 x 10 ⁻⁸
12	Transmission Time	± 0.19 %

2. TEST SUMMARY

FCC 47 CFR Part 15 Subpart E Test Cases			
Test Item	Test Requirement	Test Method	Result
Antenna Requirement	FCC 47 CFR Part 15 Subpart C Section 15.203 FCC 47 CFR Part 15 Subpart E Section 15.407(a)(1) (2) RSS-Gen Issue 5, Section 6.8	N/A	PASS
26 dB emission bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5) RSS-247 Issue 2 Section 6.2.1.2	KDB 789033 D02 v02r01 Section C.1	PASS
6 dB bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (e) RSS-247 Issue 2 Section 6.2.4.1	KDB 789033 D02 v02r01 Section C.2	PASS
Occupied Bandwidth	RSS-Gen Issue 5, Section 6.7	RSS-Gen Issue 5, section 6.7	PASS
Maximum conducted output power	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1	KDB 789033 D02 v02r01 Section E.3.a (Method PM)	PASS
Peak Power Spectral Density	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1	KDB 789033 D02 v02r01 Section F	PASS
Radiated Emissions and Band Edge Measurement	FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(1)(2)(3)(4)(6) FCC 47 CFR Part 15 Subpart C Section 15.209/205 RSS-247 Issue 2 Section 6.2.1.2/6.2.2.2/6.2.3.2/6.2.4.2	KDB 789033 D02 v02r01 Section G.3, G.4, G.5, and G.6	PASS
Dynamic Frequency Selection	FCC 47 CFR Part 15 Subpart E Section 15.407 (h) RSS-247 Issue 2 Section 6.3	KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02	PASS Note2
AC Power Line Conducted Emission	FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(6) FCC 47 CFR Part 15 Subpart C Section 15.207 RSS-Gen Issue 5, Section 8.8	ANSI C63.10-2013, Section 6.2.	PASS
Note: 1) N/A: In this whole report not applicable. 2) Please refer to Report No.: 220322031RFC-3 for DFS Test report.			
Disclaimer and Explanations: The declared of product specification and data (e.g. antenna gain, RF specification, etc) for EUT presented in the report are provided by the customer, and the customer takes all the responsibilities for the accuracy of product specification.			

3. EQUIPMENT LIST

Radiated Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
☒	3m SAC	ETS-LINDGREN	3m	Euroshiedpn-CT001270-1317	Jan. 22, 2021	Jan. 21, 2024
☒	Receiver	R&S	ESIB26	100114	Nov. 05, 2021	Nov. 04, 2022
☒	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Apr. 22, 2021	Apr. 21, 2022
					Apr. 15, 2022	Apr. 14, 2023
☒	Loop Antenna	ETS-LINDGREN	6502	00202525	Nov. 11, 2021	Nov. 10, 2023
☒	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Nov. 11, 2021	Nov. 10, 2023
☒	6dB Attenuator	Talent	RA6A5-N-18	18103001	Nov. 11, 2021	Nov. 10, 2023
☒	Preamplifier	HP	8447F	2805A02960	Nov. 05, 2021	Nov. 04, 2022
☒	Double-Ridged Waveguide Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201541	Apr. 30, 2021	Apr. 29, 2023
☒	Pre-amplifier	ETS-Lindgren	00118385	00201874	Nov. 06, 2021	Nov. 05, 2022
☒	Double-Ridged Waveguide Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	Nov. 14, 2020	Nov. 13, 2023
☒	Pre-amplifier	ETS-Lindgren	00118384	00202652	Nov. 17, 2020	Nov. 16, 2022
☒	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
☐	Band Rejection Filter (2400MHz~2500MHz)	Micro-Tronics	BRM50702	G248	Nov. 06, 2021	Nov. 05, 2022
☒	Band Rejection Filter (5150MHz~5880MHz)	Micro-Tronics	BRM50716	G186	Nov. 06, 2021	Nov. 05, 2022
☒	Test Software	Audix	e3	Software Version: 9.160323		

Conducted Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
☒	Receiver	R&S	ESR7	1316.3003K07-101181-K3	Nov. 05, 2021	Nov. 04, 2022
☒	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	Nov. 05, 2021	Nov. 04, 2022
☒	LISN	R&S	ESH2-Z5	860014/024	Nov. 05, 2021	Nov. 04, 2022
☒	LISN	ETS-Lindgren	3816/2SH	00201088	Nov. 05, 2021	Nov. 04, 2022
☒	Test Software	Audix	e3	Software Version: 9.160323		

Conducted RF test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
☒	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Apr. 22, 2021	Apr. 21, 2022
					Apr. 15, 2022	Apr. 14, 2023
☒	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	Nov. 05, 2021	Nov. 04, 2022
☐	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	Nov. 05, 2021	Nov. 04, 2022
☒	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	Nov. 05, 2021	Nov. 04, 2022
☒	Spectrum Analyzer	R&S	FSV40-N	101653	Apr. 22, 2021	Apr. 21, 2022

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4. TEST CONFIGURATION

4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

4.1.1 Normal or Extreme Test Conditions

Environment Parameter	Selected Values During Tests		
Test Condition	Ambient		
	Temperature (°C)	Voltage	Relative Humidity (%)
NT/NV	+15 to +35	12	20 to 75
Remark: 1) NV: Normal Voltage; NT: Normal Temperature			

4.1.2 Record of Normal Environment and Test Sample

Test Item	Temperature (°C)	Relative Humidity (%)	Pressure (kPa)	Sample No.	Tested by
26 dB emission bandwidth	23.2	49	100.2	220322031-A02/2	Rain Wang
6 dB bandwidth					
Occupied Bandwidth					
Maximum conducted output power					
Peak Power Spectral Density					
Radiated Emissions Measurement	25.3	52	100.12	220322031-B04/4	Asia Yan
Band Edge Measurement	23.2	49	100.2	220322031-B03/4	Rain Wang
Dynamic Frequency Selection					
AC Power Line Conducted Emission	25.1	42	101.1	220322031-B01/4	David Zhang

4.2 TEST CHANNELS

Mode	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
IEEE 802.11a IEEE 802.11n-HT20 IEEE 802.11ac-VHT20	5150 MHz to 5250 MHz	Channel 36	Channel 44	Channel 48
		5180 MHz	5220 MHz	5240 MHz
	5250 MHz to 5350 MHz	Channel 52	Channel 60	Channel 64
		5260 MHz	5300 MHz	5320 MHz
	5470 MHz to 5725 MHz	Channel 100	Channel 116	Channel 140
		5500 MHz	5580 MHz	5700 MHz
	5725 MHz to 5850 MHz	Channel 149	Channel 157	Channel 165
		5745 MHz	5785 MHz	5825 MHz
IEEE 802.11n-HT40 IEEE 802.11ac-VHT40	5150 MHz to 5250 MHz	Channel 38	--	Channel 46
		5190 MHz	--	5230 MHz
	5250 MHz to 5350 MHz	Channel 54	--	Channel 62
		5270 MHz	--	5310 MHz
	5470 MHz to 5725 MHz	Channel 102	Channel 110	Channel 134
		5510 MHz	5550 MHz	5670 MHz
	5725 MHz to 5850 MHz	Channel 151	--	Channel 159
		5755 MHz	--	5795 MHz
IEEE 802.11ac-VHT80	5150 MHz to 5250 MHz	--	Channel 42	--
		--	5210 MHz	--
	5250 MHz to 5350 MHz	--	Channel 58	--
		--	5290 MHz	--
	5470 MHz to 5725 MHz	Channel 106	--	--
		5530 MHz	--	--
	5725 MHz to 5850 MHz	--	Channel 155	--
		--	5775 MHz	--

4.3 EUT TEST STATUS

Mode	Tx/Rx Function	Description
IEEE 802.11a/n/ac	1Tx/1Rx or 2Tx/2Rx	1. Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate.

Power Setting(Provided by the customer)										
Mode	U-NII-1				U-NII-2A		U-NII-2C		U-NII-3	
	FCC		ICES		(FCC&ICES)					
	Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1
IEEE 802.11a	23	23	17	17	23	23	1E	1E	26	26
IEEE 802.11n-HT20	20	20	0E	0E	1B	1B	1B	1B	26	26
IEEE 802.11n-HT40	1E	1E	15	15	1E	1E	1C	1C	26	26
IEEE 802.11ac-VHT20	20	20	0E	0E	1B	1B	1B	1B	26	26
IEEE 802.11ac-VHT40	1E	1E	15	15	1E	1E	1C	1C	26	26
IEEE 802.11ac-VHT80	19	19	19	19	19	19	16	16	26	26

Note: Regarding the frequency band U-NII-1, except for Maximum conducted output power and Peak Power Spectral Density, other items only reflect the data of the highest power setting.

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Test Software(Provided by the customer)
Test software name: MT7615 QA 0.0.1.91;

4.4 PRE-SCAN

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate. Following data rate was (were) selected for the final test as listed below

Mode	Worst-case data rates
IEEE 802.11a	6 Mbps
IEEE 802.11n-HT20	MCS8
IEEE 802.11n-HT40	MCS8
IEEE 802.11ac-VHT20	MCS0
IEEE 802.11ac-VHT40	MCS0
IEEE 802.11ac-VHT80	MCS0

4.5 TEST SETUP

4.5.1 For Radiated Emissions test setup

Figure 1. Below 30MHz

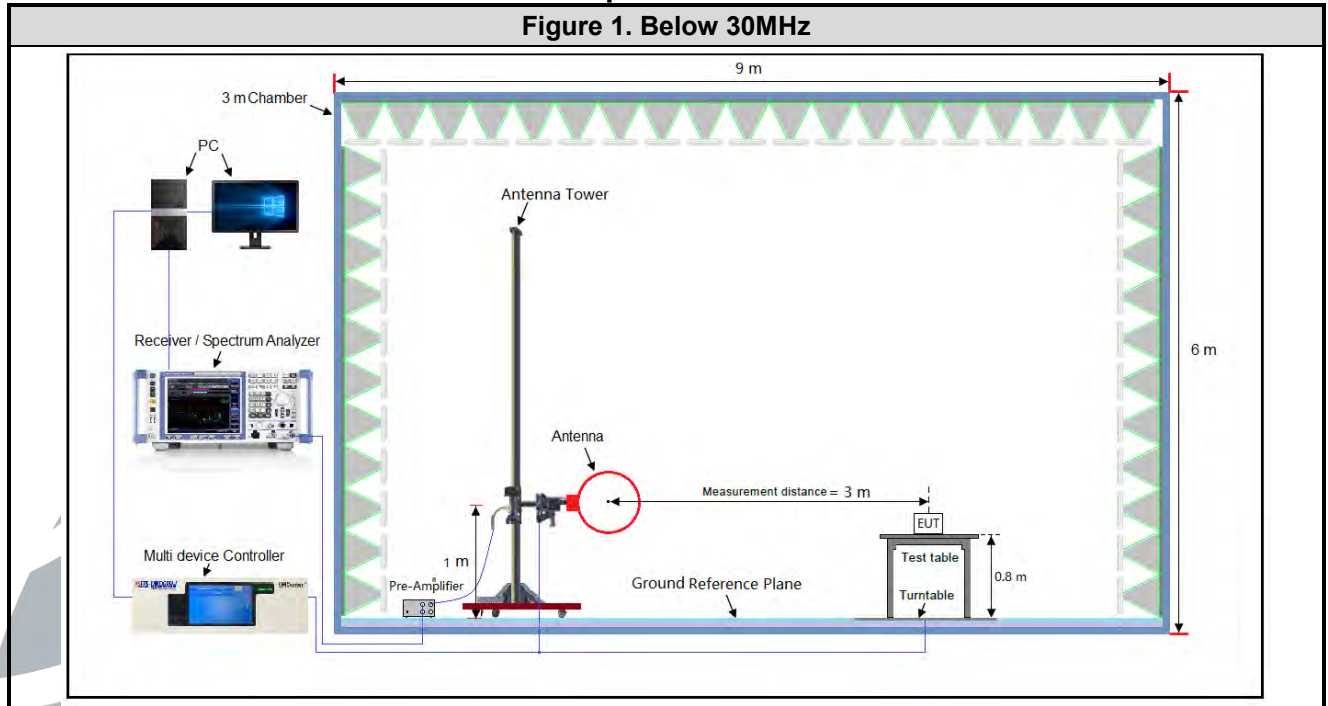
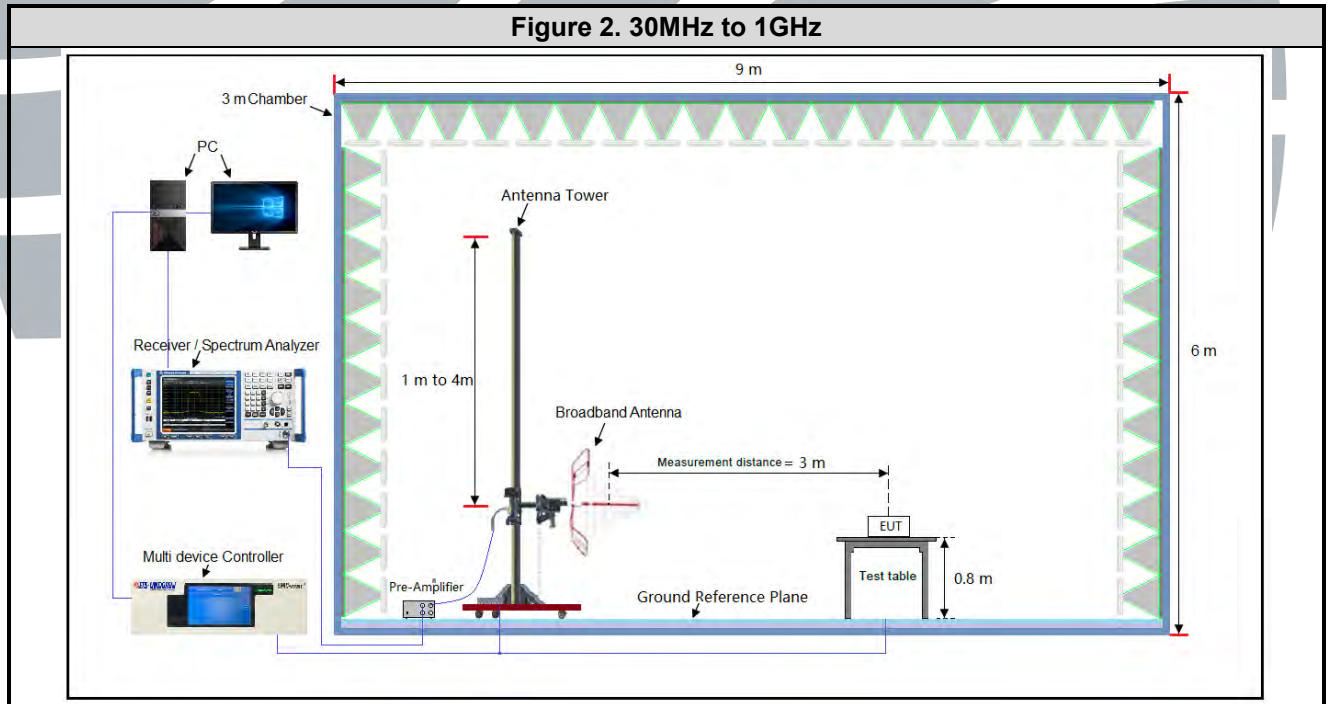
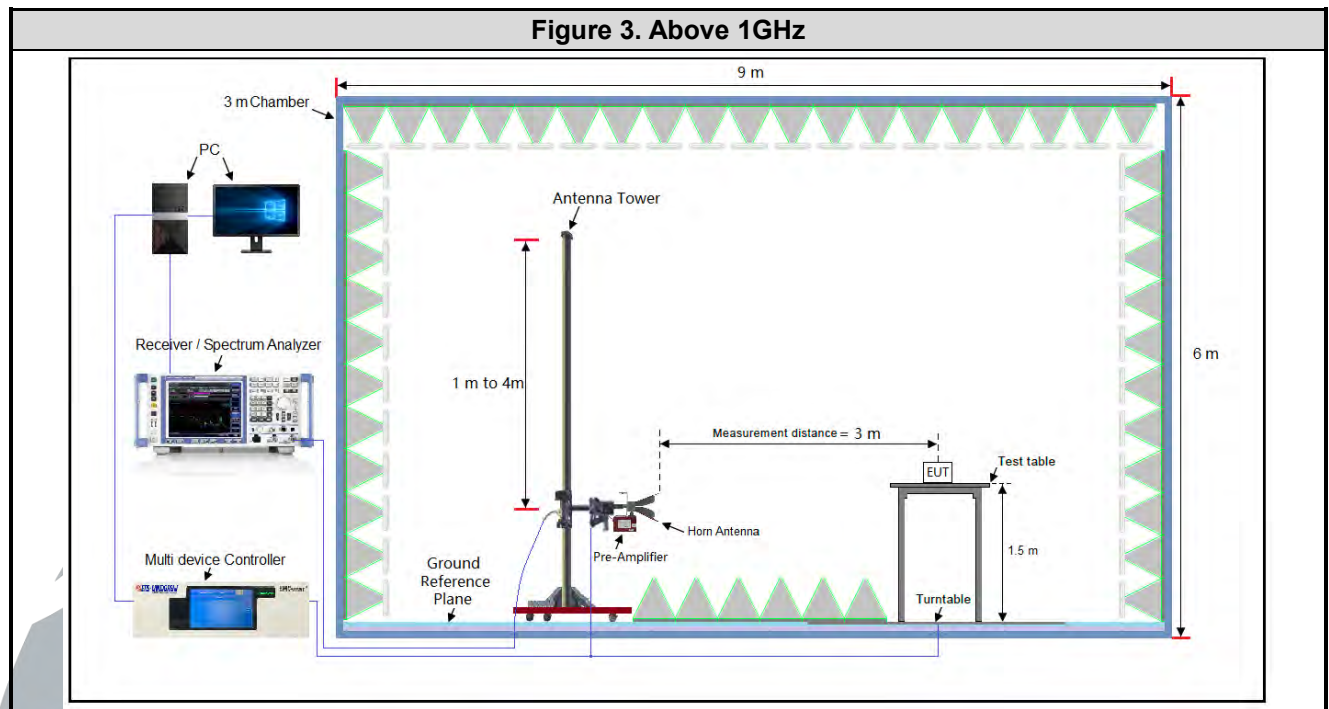
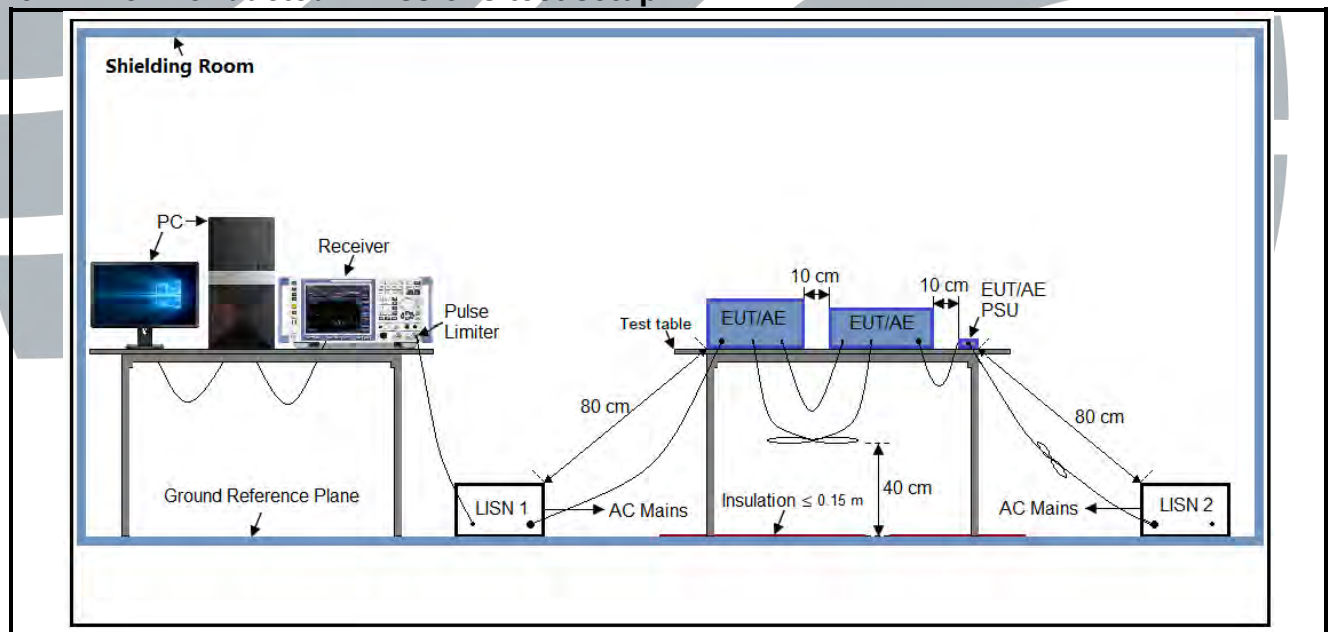


Figure 2. 30MHz to 1GHz

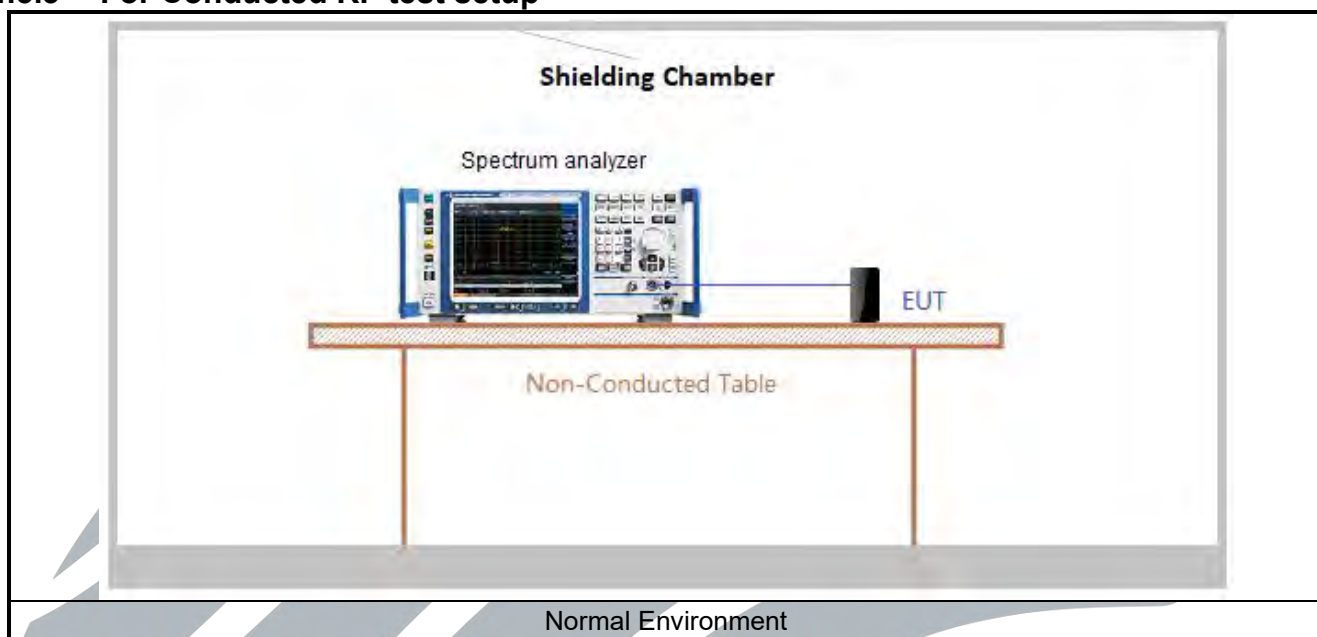




4.5.2 For Conducted Emissions test setup



4.5.3 For Conducted RF test setup



4.6 SYSTEM TEST CONFIGURATION

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. Only the worst case data were recorded in this test report.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Therefore, all final radiated testing was performed with the EUT in (see table below) orientation.

Frequency	Mode	Antenna Port	Worst-case axis positioning
Above 1GHz	1TX	Chain 0	Z axis
	1TX	Chain 1	Z axis
	2TX	Chain 0+1	Z axis

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

4.7 DUTY CYCLE

Test Procedure: ANSI C63.10-2013 Clause 12.2.

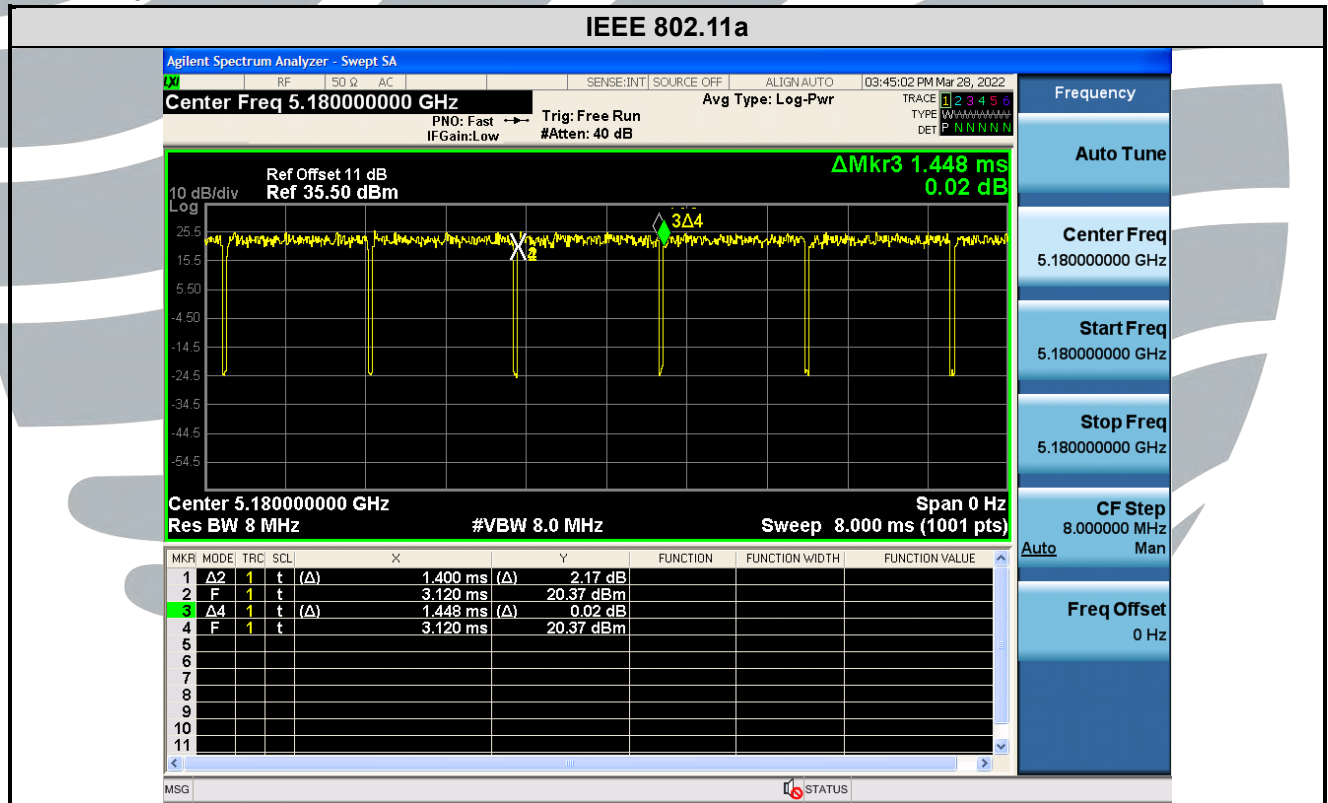
Test Results

Mode	Data rates (Mbps)	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)	Average Factor (dB)
IEEE 802.11a	6	1.400	1.448	0.97	96.69	0.15	0.71	-0.29
IEEE 802.11n-HT20	MCS8	1.304	1.360	0.96	95.88	0.18	0.77	-0.37
IEEE 802.11n-HT40	MCS8	0.645	0.700	0.92	92.14	0.36	1.55	-0.71
IEEE 802.11ac-VHT20	MCS0	0.680	0.735	0.93	92.52	0.34	1.47	-0.68
IEEE 802.11ac-VHT40	MCS0	0.351	0.402	0.87	87.31	0.59	2.85	-1.18
IEEE 802.11ac-VHT80	MCS0	0.189	0.519	0.36	36.42	4.39	5.29	-8.77

Remark:

- 1) Duty cycle= On Time/ Period;
- 2) Duty Cycle factor = $10 * \log(1/ \text{Duty cycle})$;
- 3) Average factor = $20 \log_{10} \text{Duty Cycle}$.

The test plots as follows



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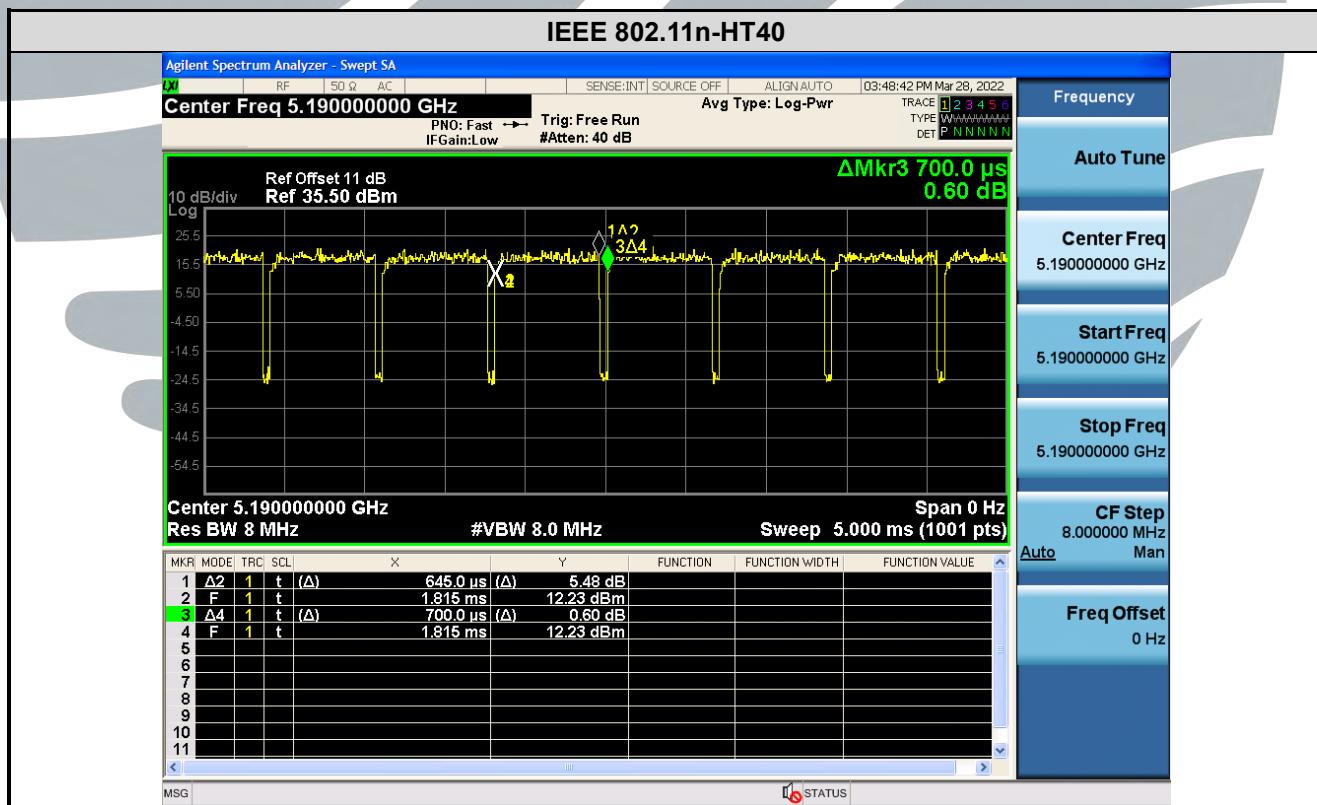
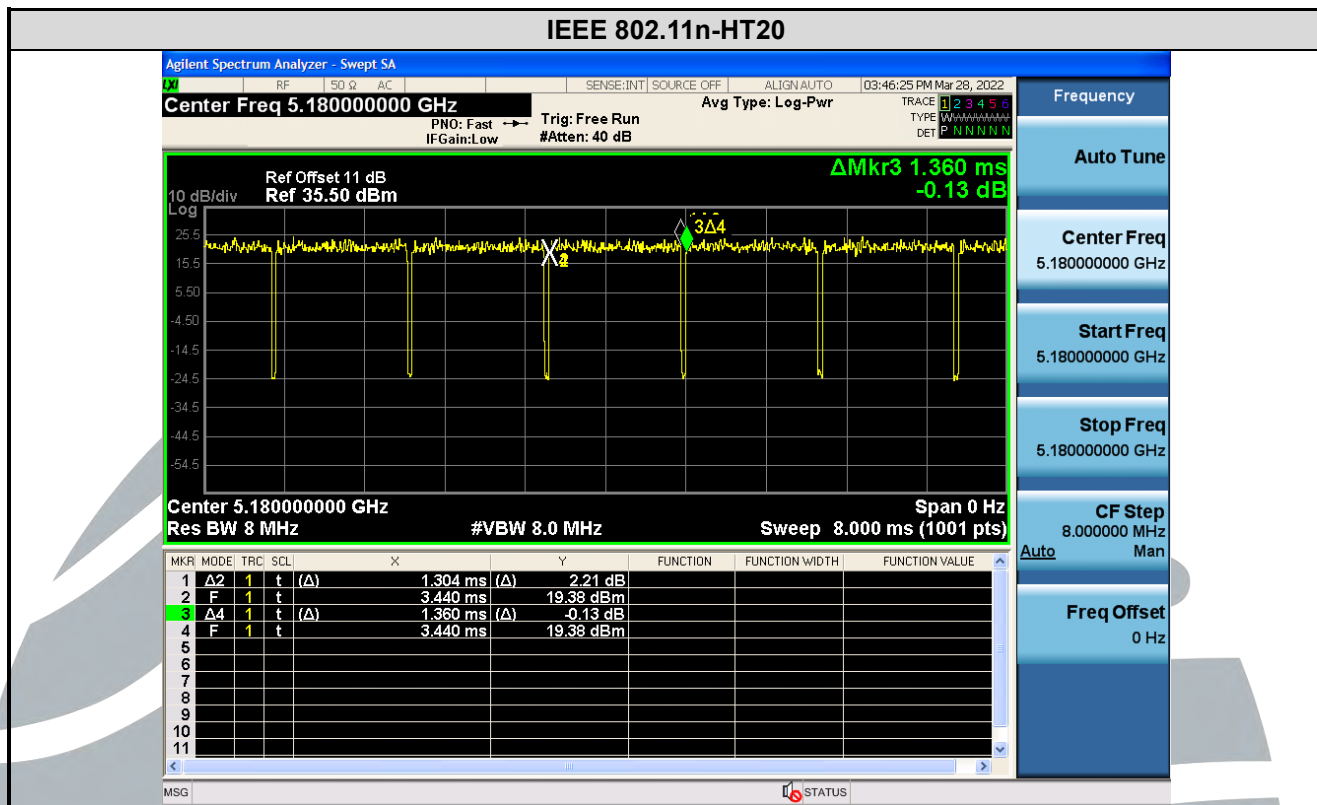
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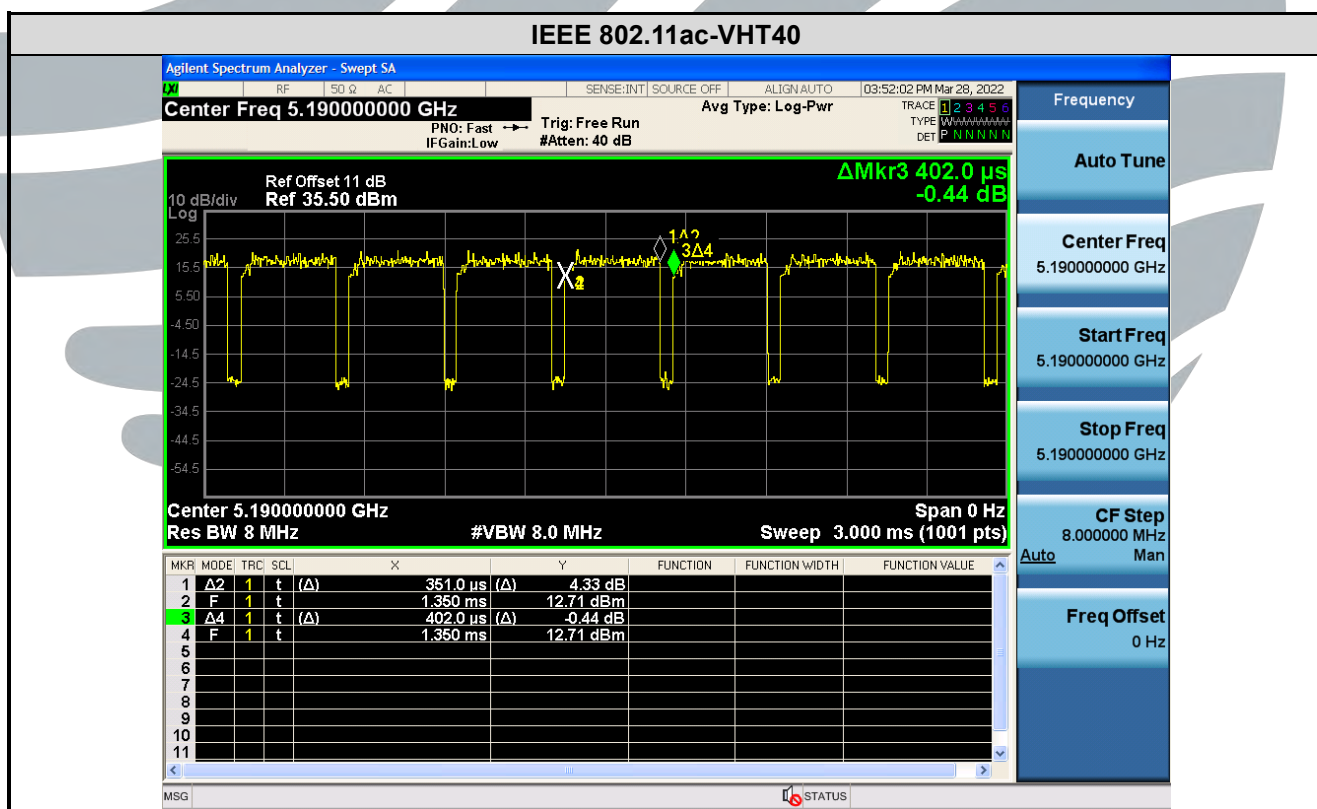
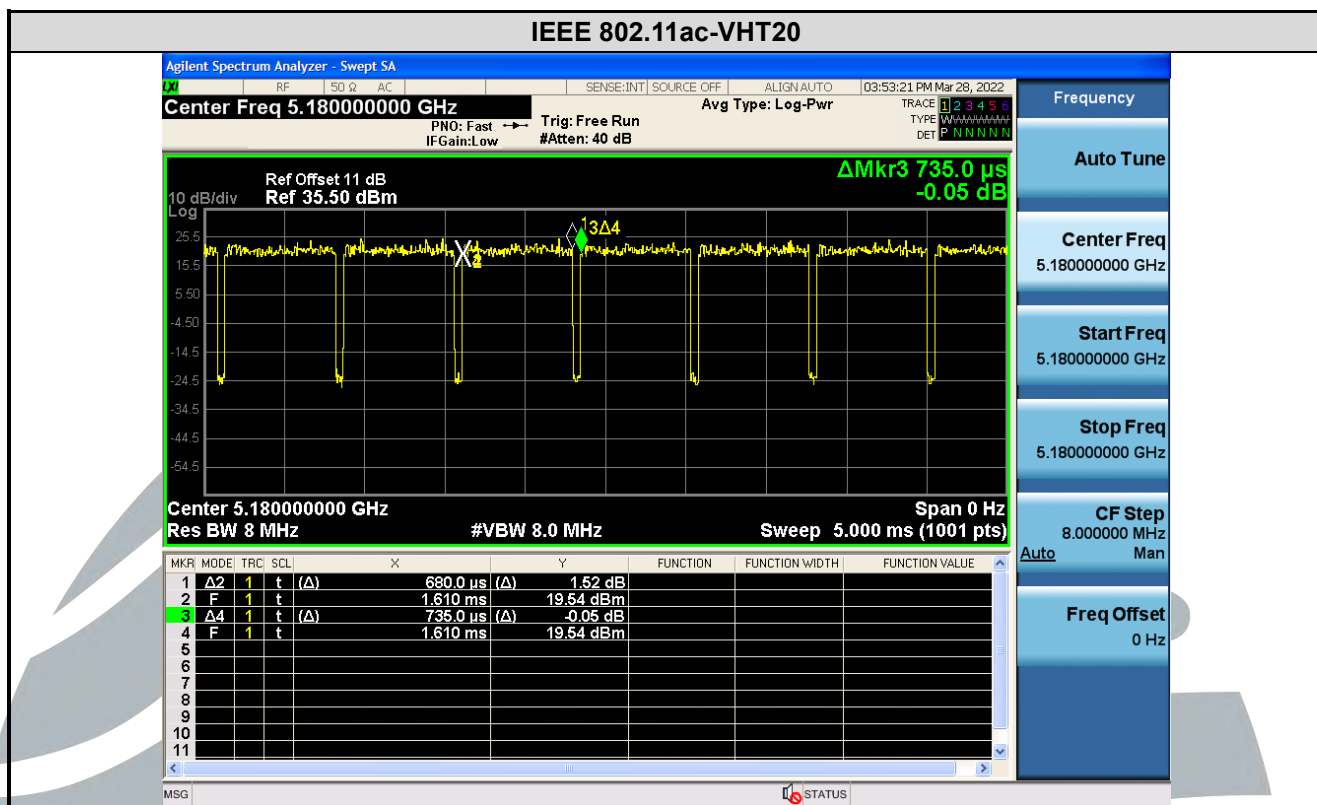
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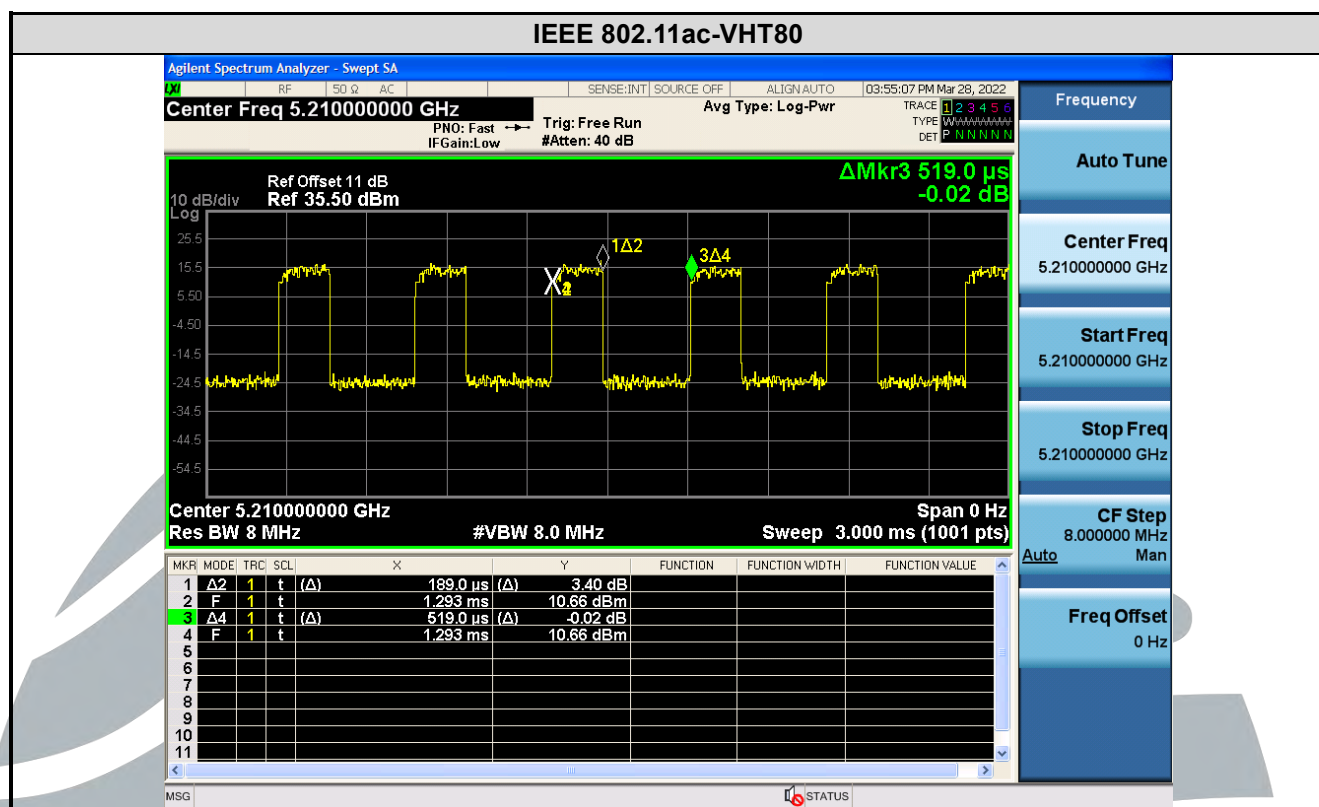
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5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

5.1 REFERENCE DOCUMENTS FOR TESTING

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
4	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus
5	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
6	KDB 789033 D02 General UNII Test Procedures New Rules v02r01	Guidelines for compliance testing of unlicensed national information infrastructure (U-NII) device part 15, subpart E
7	KDB 905462 D06 802.11 Channel Plans New Rules v02	Operation in U-NII bands -802.11 channel PLAN(§15.407)
8	KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02	Compliance measurement procedures for Unlicensed –National Information Infrastructure devices operates in the frequency bands 5250 MHz to 5350 MHz and 5470 MHz to 5725 MHz bands incorporating dynamic frequency selection
9	KDB 662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

5.2 ANTENNA REQUIREMENT

Standard Requirement
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. 15.407(a)(1) (2) requirement: The conducted output power limit specified in paragraph (a) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (a) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power and the peak power spectral density shall be reduced by the by the amount in dB that the directional gain of the antenna exceeds 6 dBi. RSS-Gen Issue 5, Section 6.8 requirement: According to RSS-Gen Issue 5, Section 6.8, a transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. EUT Antenna: Both antenna connector in the interior of the equipment and no consideration of replacement. The transmit signals are correlated with each other, the best case directional gain of the antenna is 5.0 dBi (See section 5.5).

5.326 DB BANDWIDTH & OCCUPIED BANDWIDTH

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5)
RSS-247 Issue 2 Section 6.2.1.2

Test Method: KDB 789033 D02 v02r01 Section C.1

Limit: None; for reporting purposes only.

Test Procedure:

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum analyzer.

Spectrum analyzer according to the following Settings:

a) Set RBW = approximately 1 % of the emission bandwidth.

b) Set the VBW > RBW.

c) Detector = Peak.

d) Trace mode = max hold.

e) Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Results: Pass

Mode	Channel	26 dB Bandwidth (MHz)		99% Bandwidth (MHz)	
		Chain 0	Chain 1	Chain 0	Chain 1
IEEE 802.11a	36 (5180)	26.46	28.22	16.798	16.747
	44 (5220)	25.87	27.76	16.739	16.589
	48 (5240)	26.35	26.79	16.848	16.560
	52 (5260)	19.79	19.67	16.618	16.442
	60 (5300)	19.92	19.82	16.589	16.445
	64 (5320)	19.84	19.50	16.596	16.415
	100 (5500)	19.70	19.56	16.587	16.426
	116 (5580)	19.90	19.74	16.553	16.448
	140 (5700)	19.91	19.72	16.573	16.429
IEEE 802.11n-HT20	36 (5180)	19.99	22.29	17.608	17.668
	44 (5220)	20.28	19.89	17.658	17.577
	48 (5240)	20.16	20.08	17.571	17.612
	52 (5260)	19.97	20.15	17.615	17.615
	60 (5300)	20.22	20.03	17.625	17.638
	64 (5320)	20.33	20.09	17.642	17.608
	100 (5500)	20.27	20.01	17.632	17.558
	116 (5580)	20.09	20.05	17.631	17.602
	140 (5700)	20.26	20.07	17.610	17.630
IEEE 802.11n-HT40	38 (5190)	40.87	39.74	36.125	35.991
	46 (5230)	40.93	40.01	36.161	35.914
	54 (5270)	40.29	39.99	36.018	36.070
	62 (5310)	40.72	39.97	36.024	35.999
	102 (5510)	40.50	40.08	35.983	35.961
	110 (5550)	40.56	40.33	36.130	36.145
	134 (5670)	40.65	40.39	36.107	36.060

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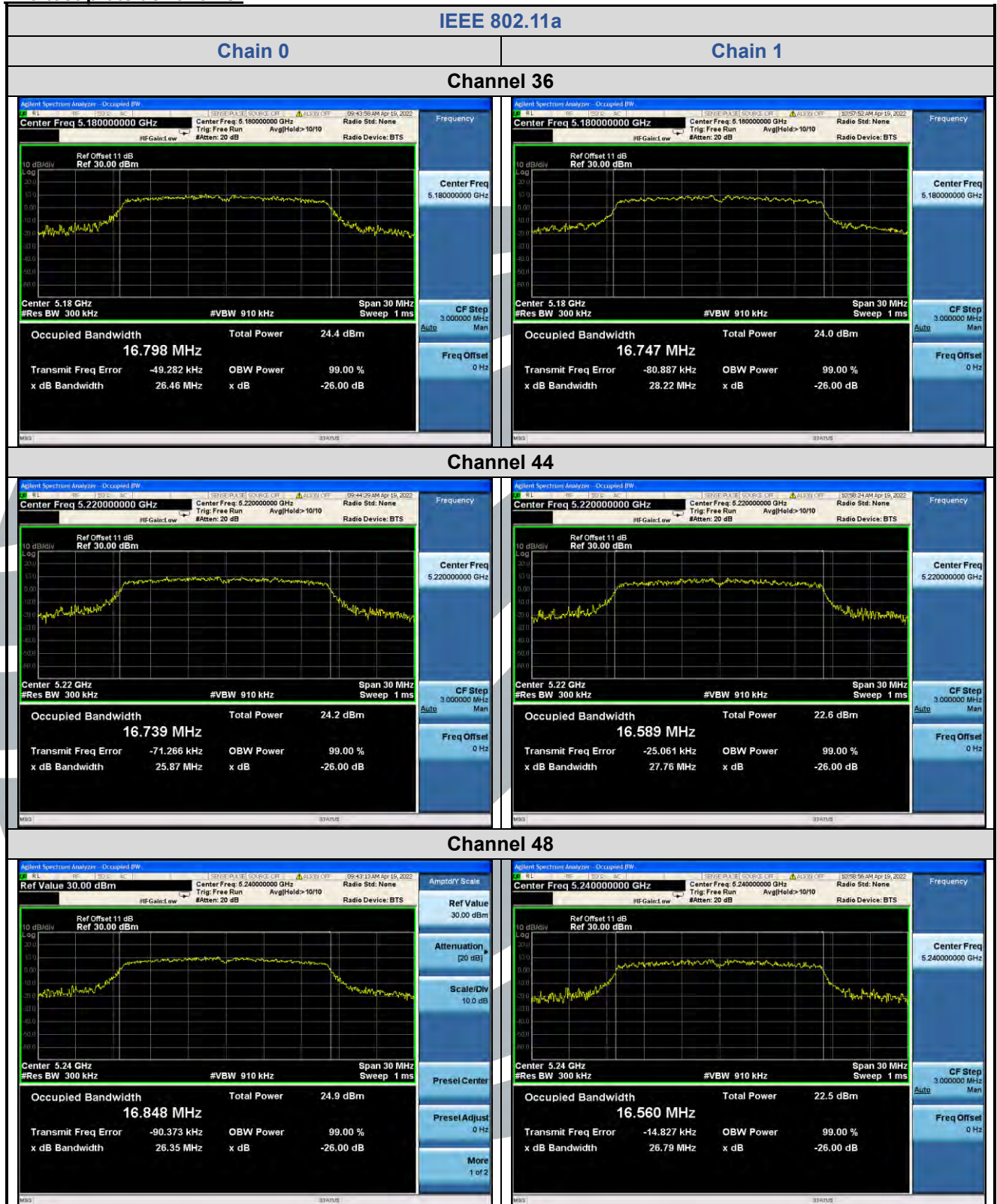
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IEEE 802.11ac-VHT20	36 (5180)	20.12	20.23	17.646	17.628
	44 (5220)	20.23	20.10	17.636	17.607
	48 (5240)	20.25	20.24	17.605	17.611
	52 (5260)	20.16	20.12	17.602	17.618
	60 (5300)	20.19	20.32	17.614	17.608
	64 (5320)	20.33	20.12	17.611	17.623
	100 (5500)	20.26	20.06	17.607	17.631
	116 (5580)	20.36	20.15	17.627	17.631
	140 (5700)	20.19	20.14	17.615	17.571
IEEE 802.11ac-VHT40	38 (5190)	40.73	40.00	36.094	36.071
	46 (5230)	40.47	40.35	36.110	36.014
	54 (5270)	39.99	39.91	36.022	36.070
	62 (5310)	40.67	40.20	36.095	35.987
	102 (5510)	40.23	40.18	36.023	35.921
	110 (5550)	40.40	40.15	36.130	36.068
	134 (5670)	40.72	39.91	36.095	35.977
IEEE 802.11ac-VHT80	42 (5210)	80.37	79.82	75.073	75.148
	58 (5290)	80.81	80.31	75.032	75.070
	106 (5530)	80.59	80.20	74.954	74.951

The test plots as follows:



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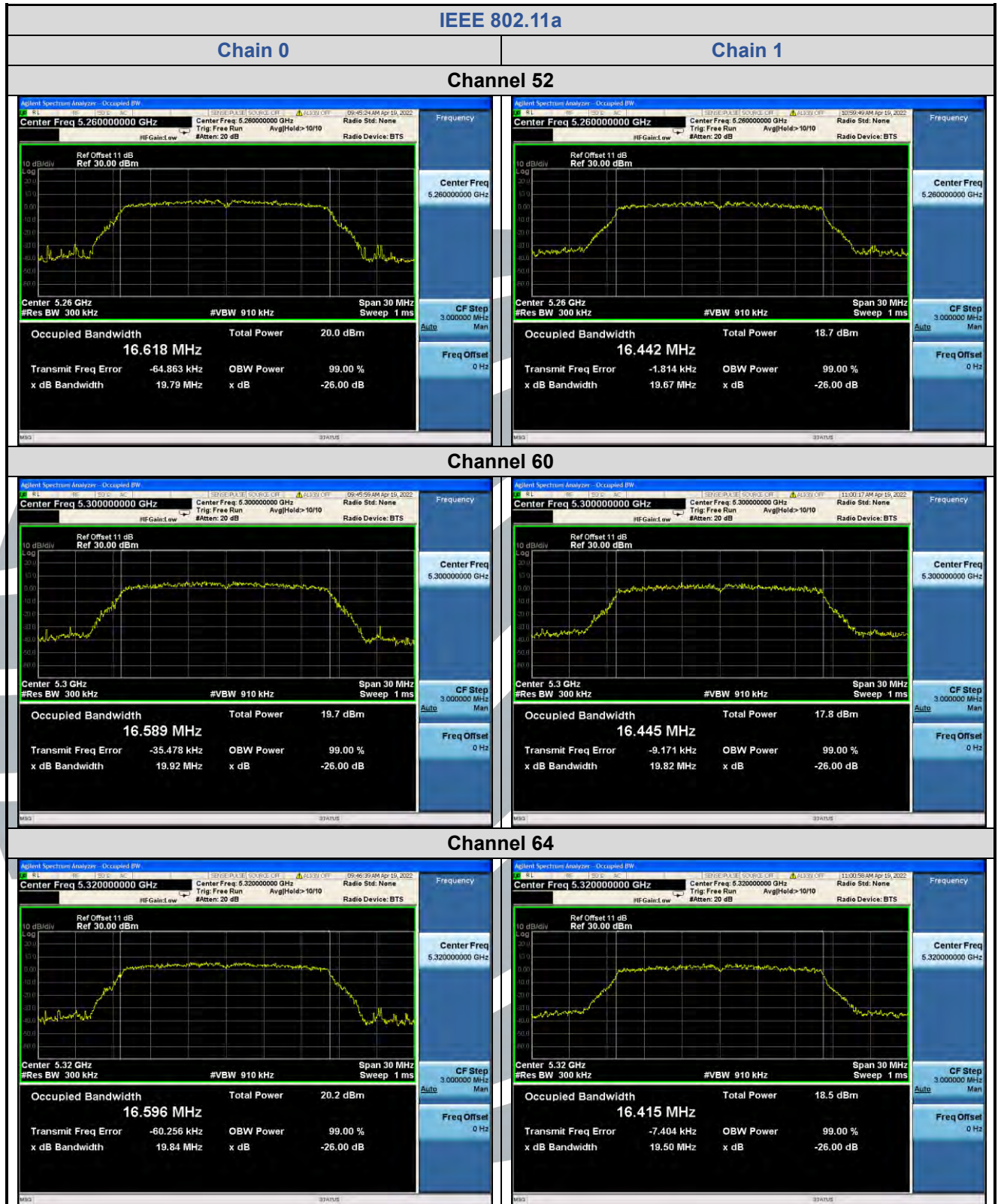
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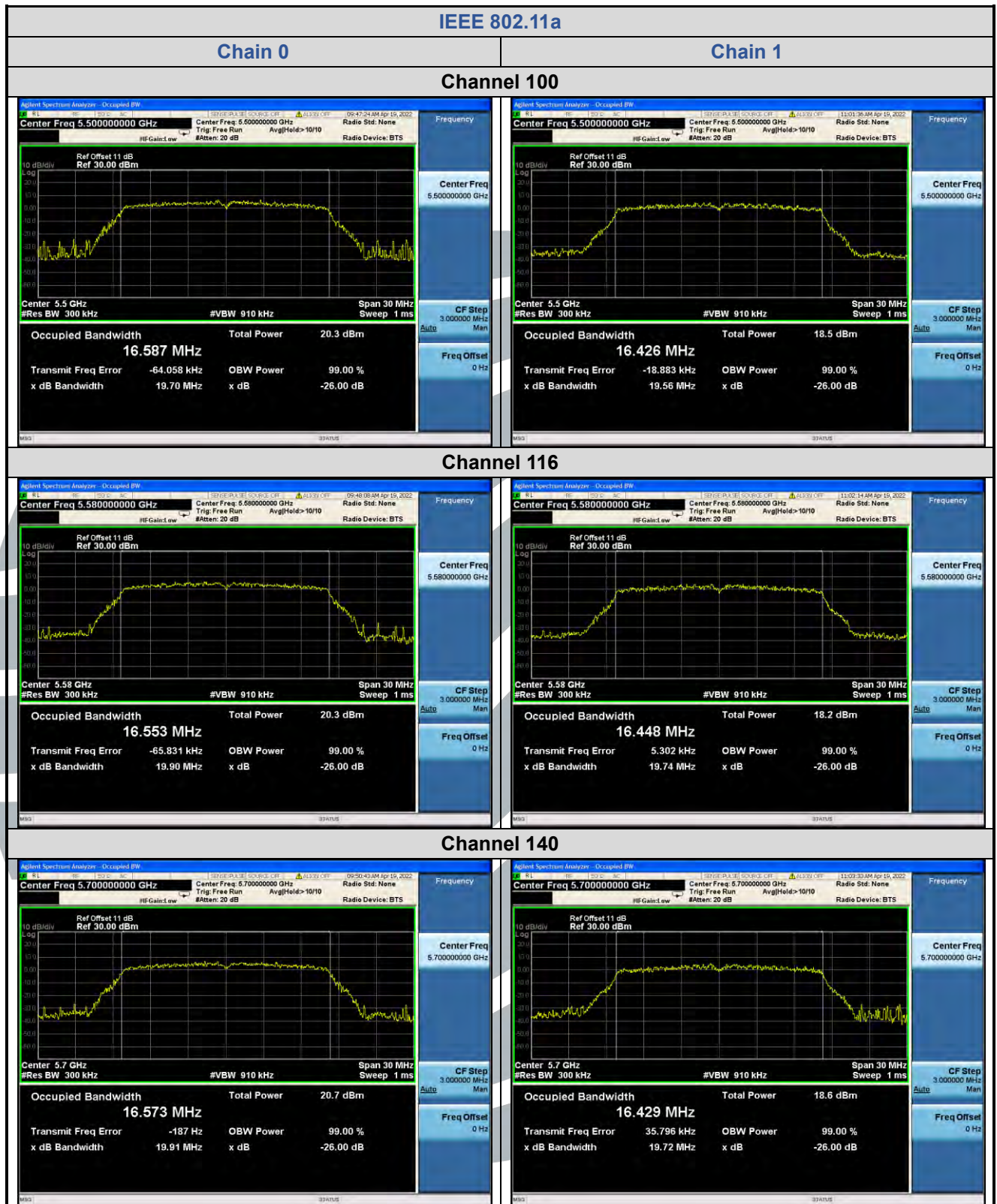
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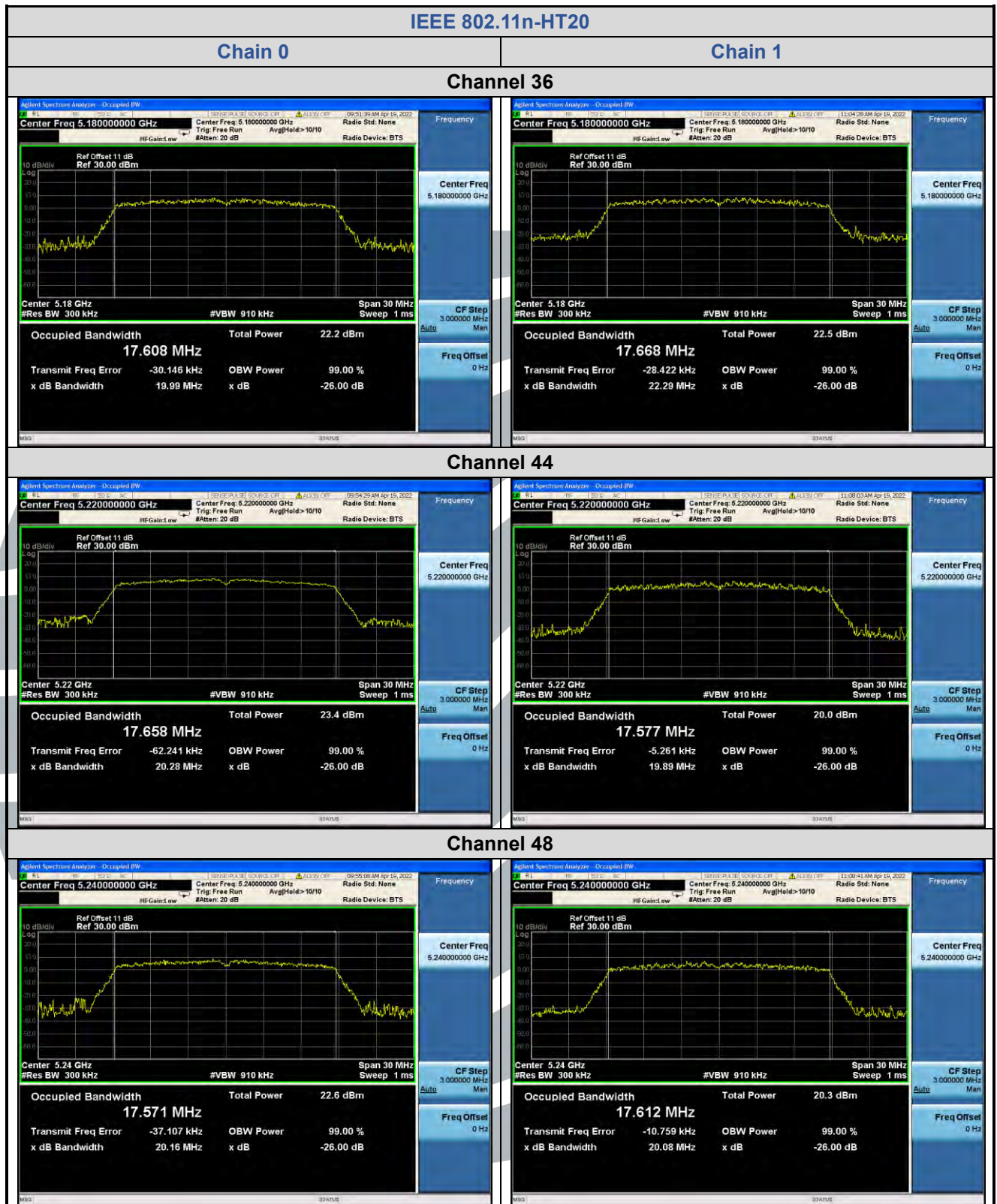
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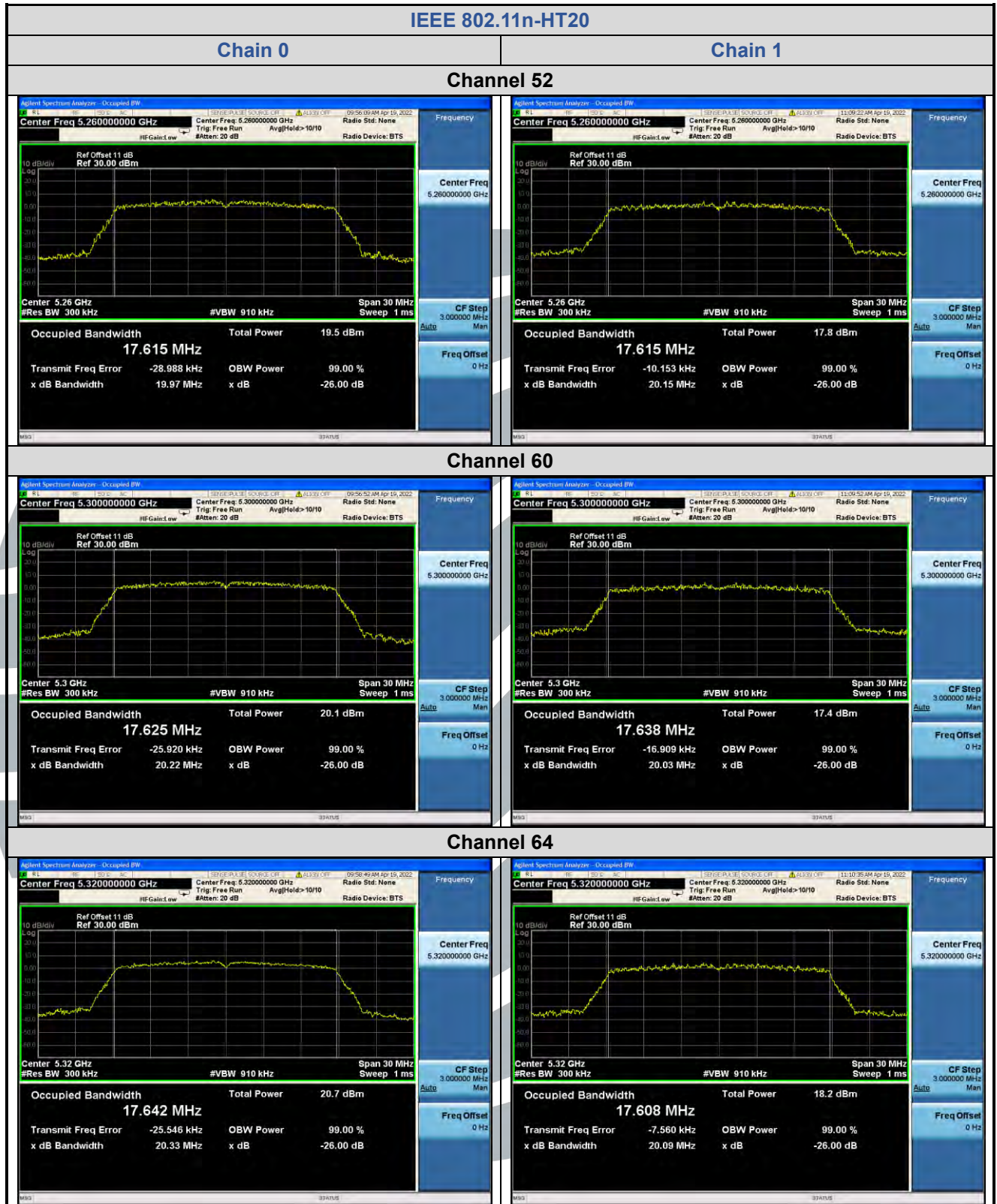
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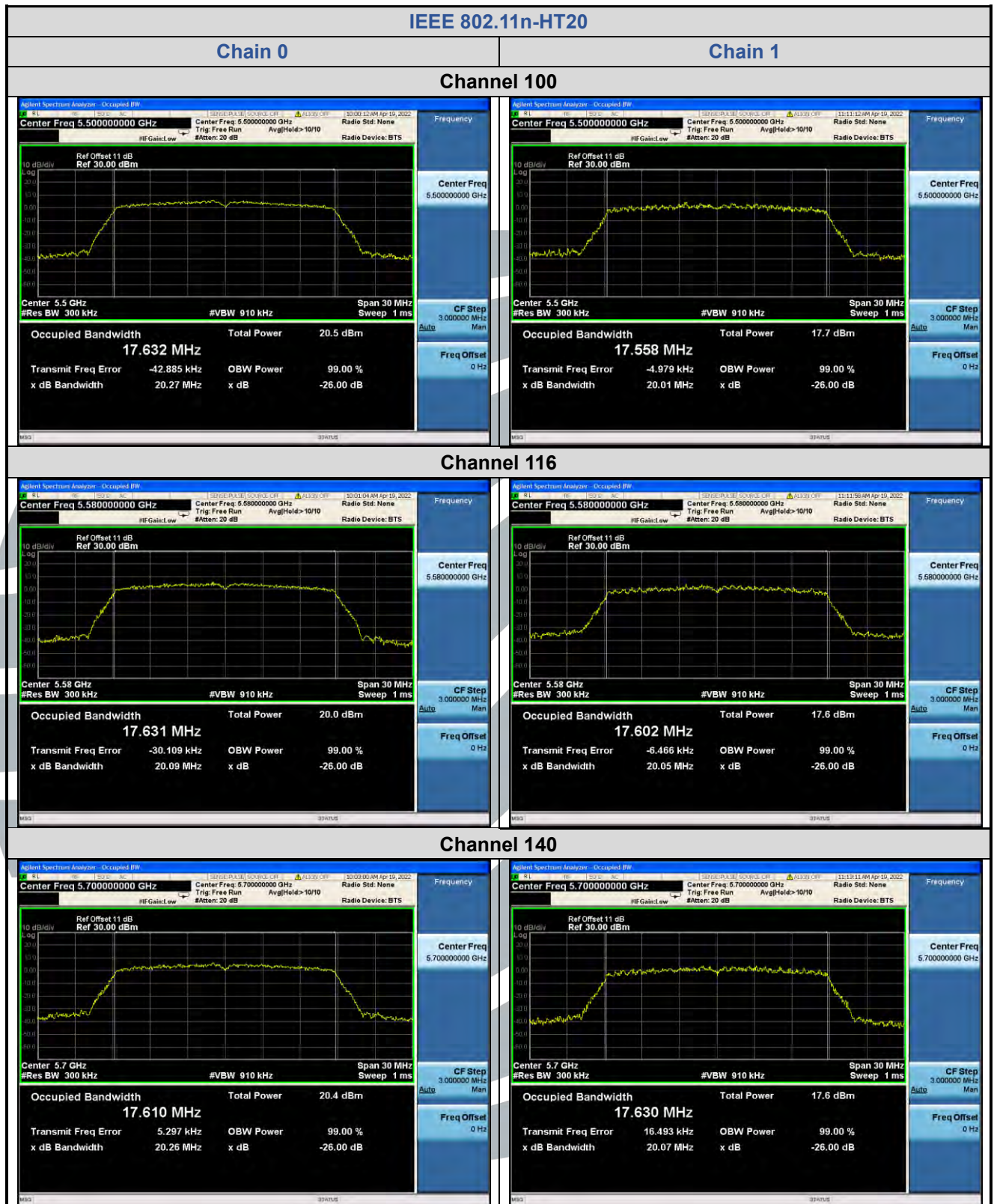
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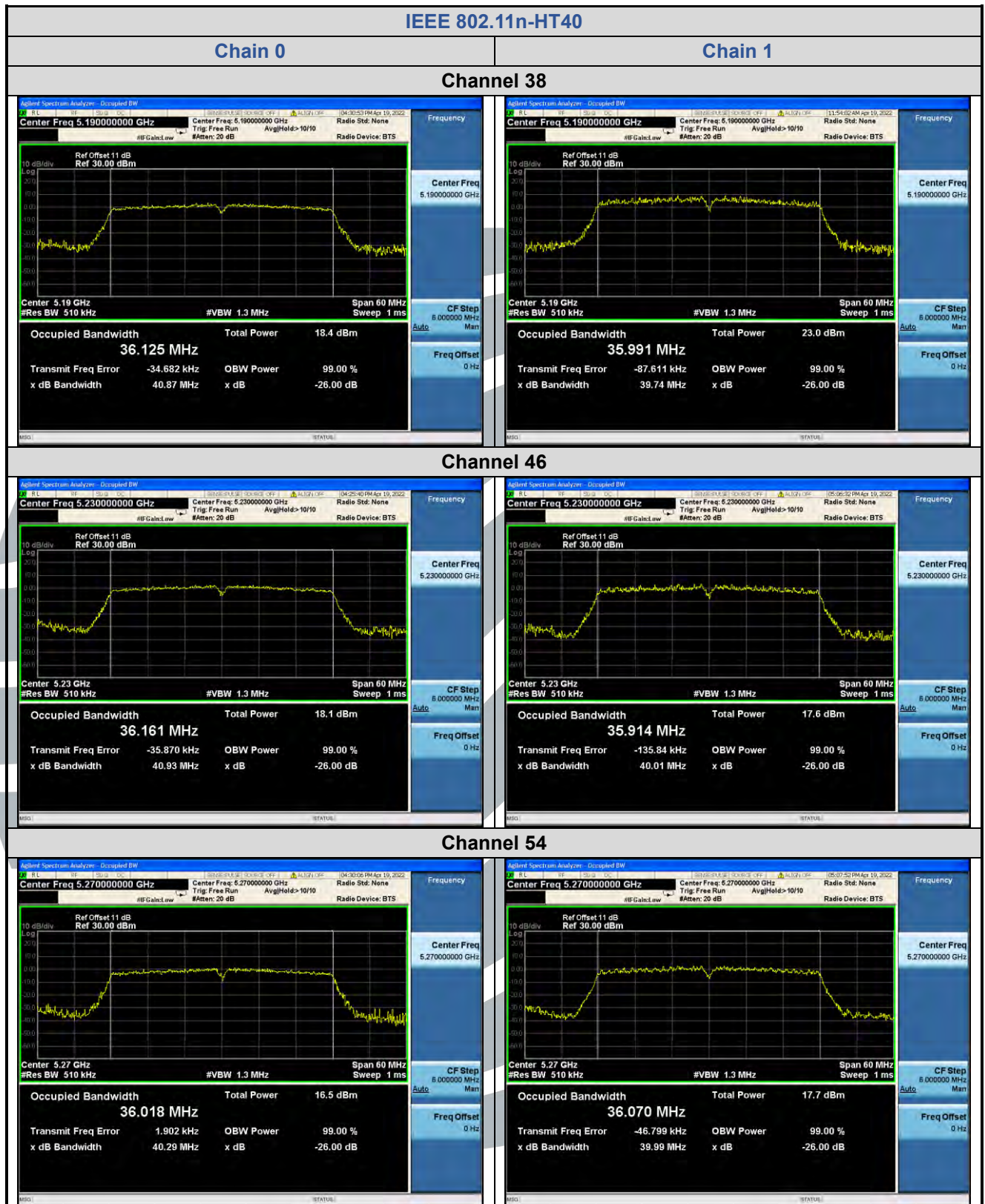


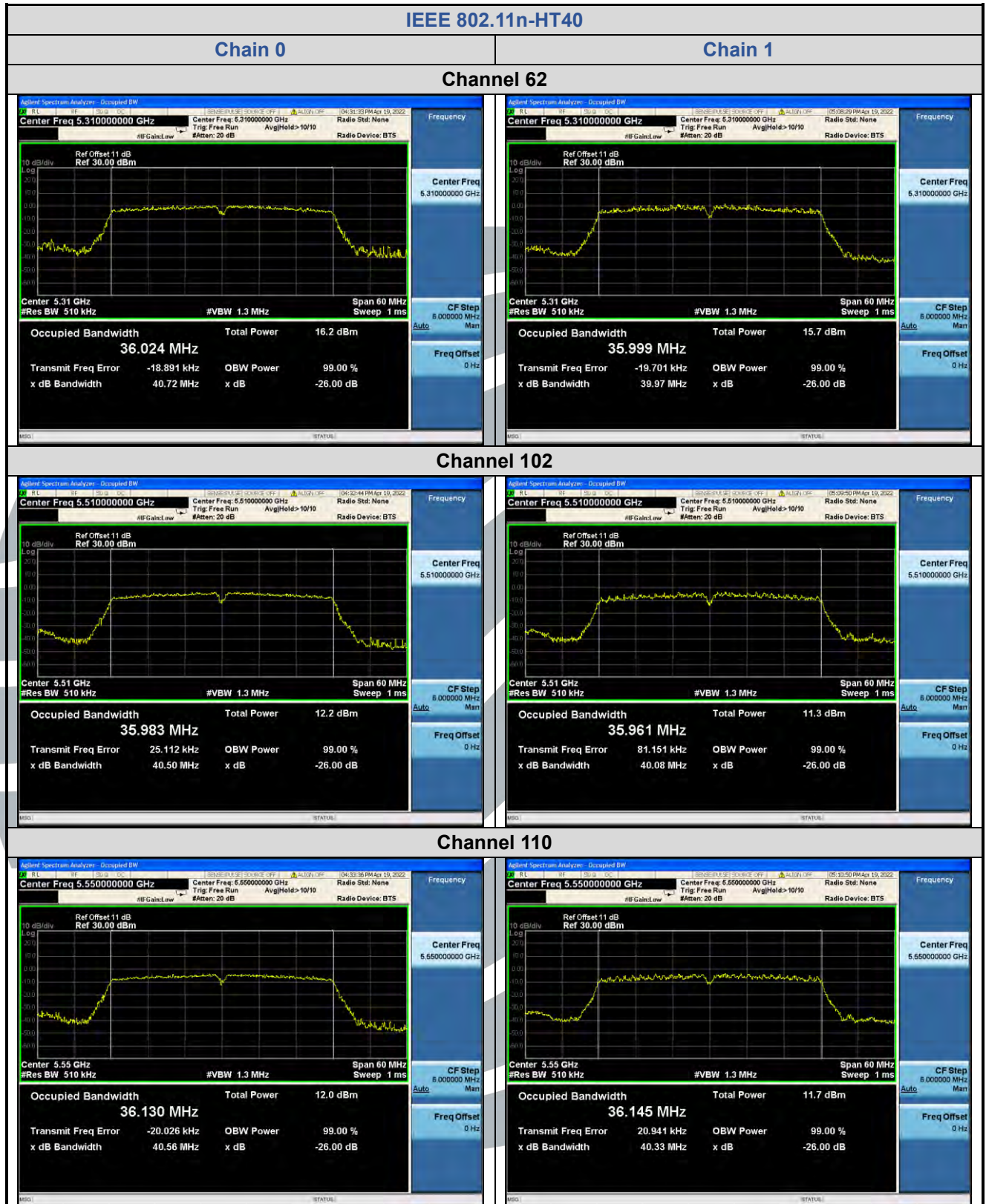


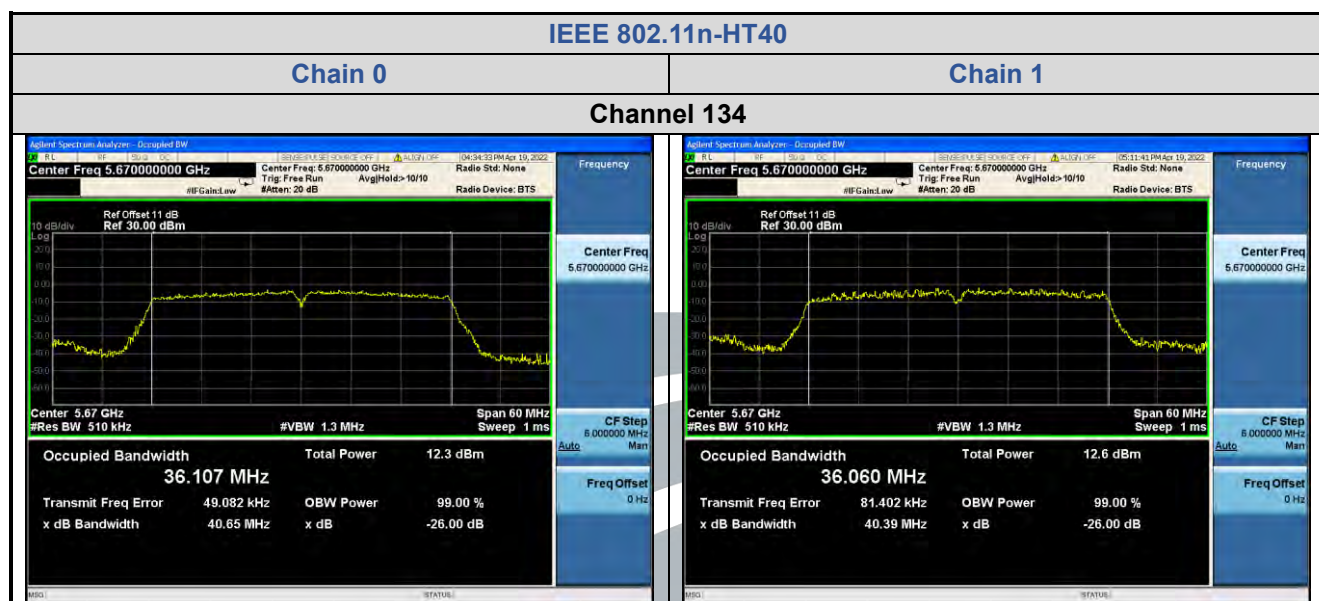












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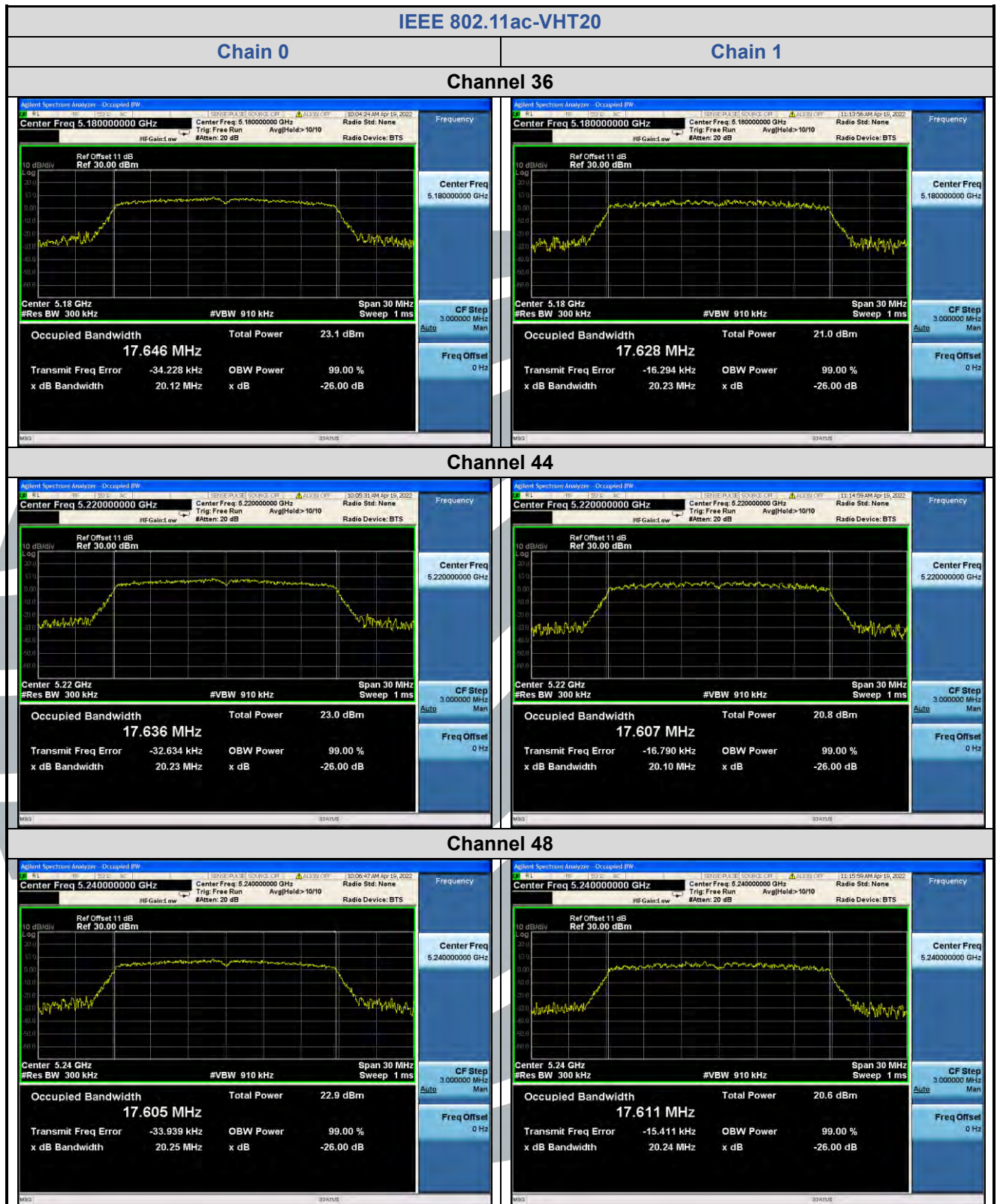
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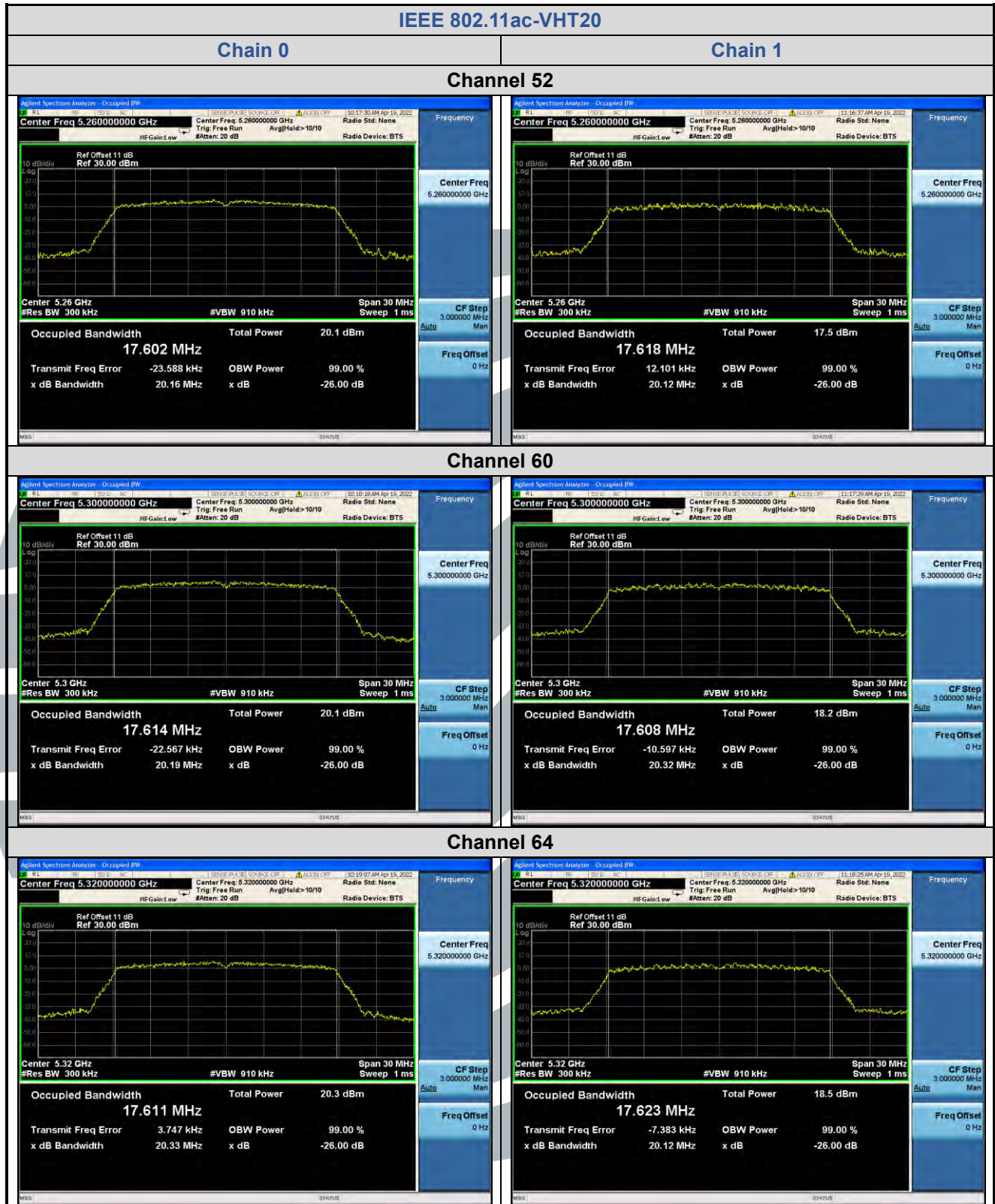
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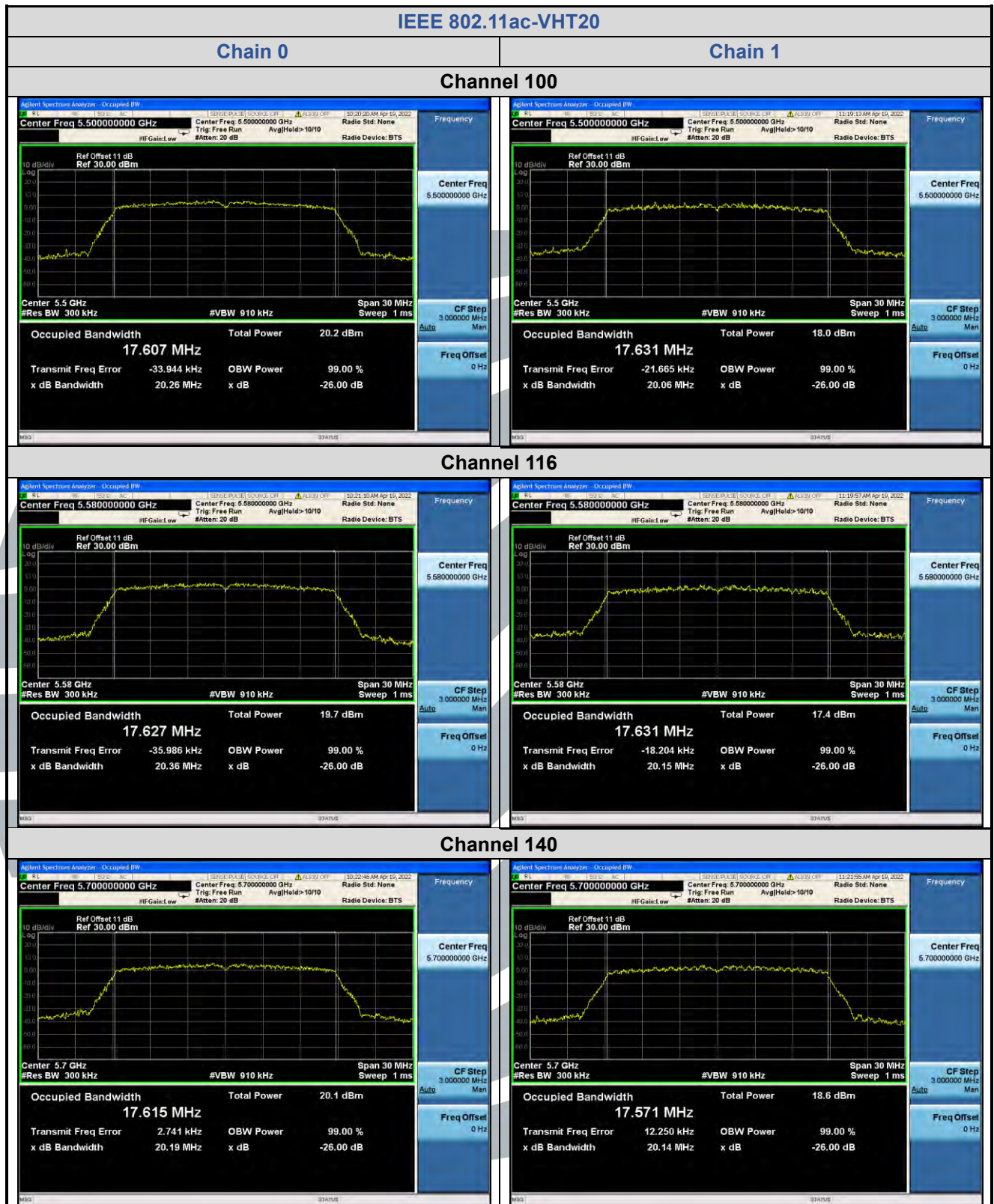
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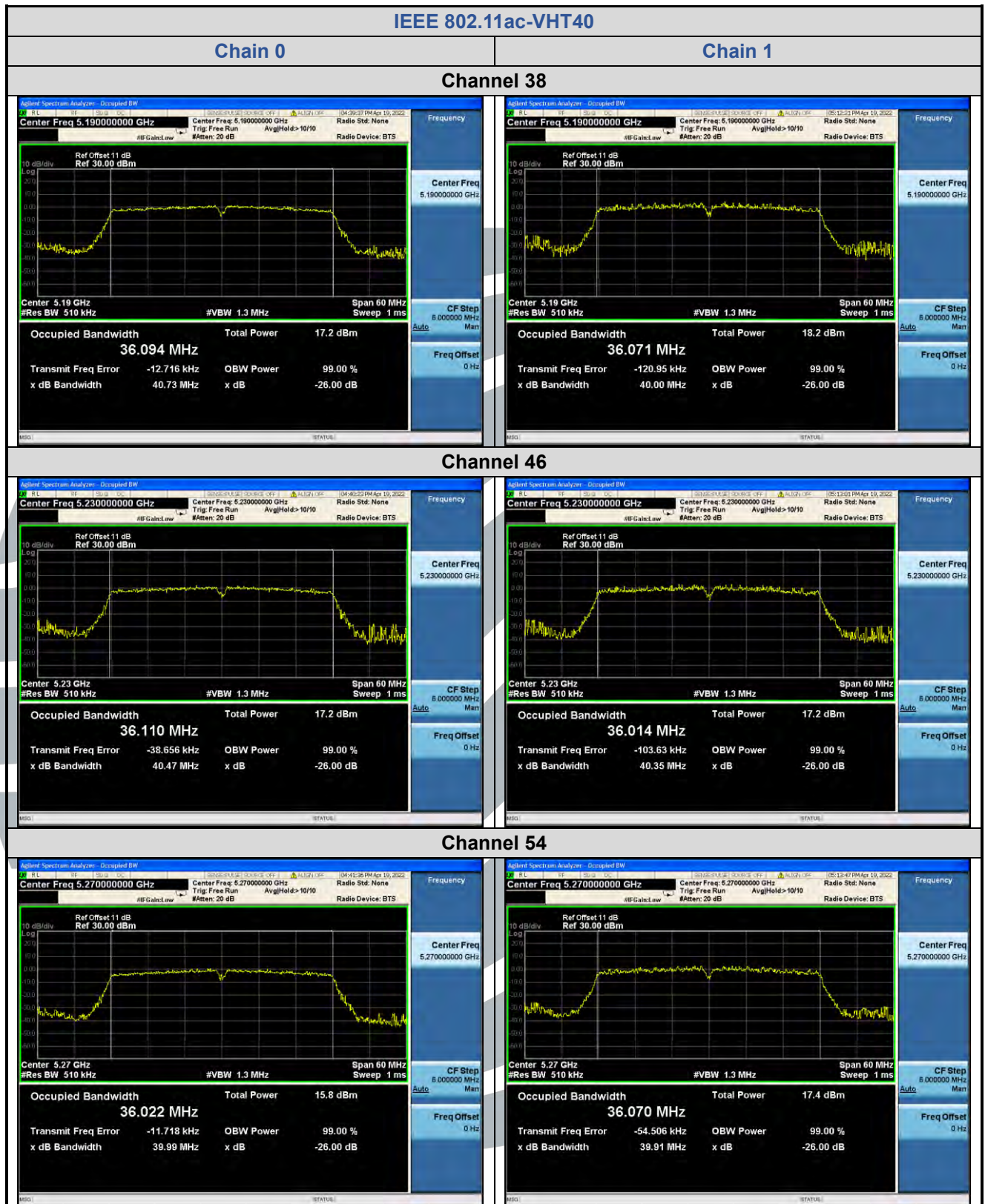
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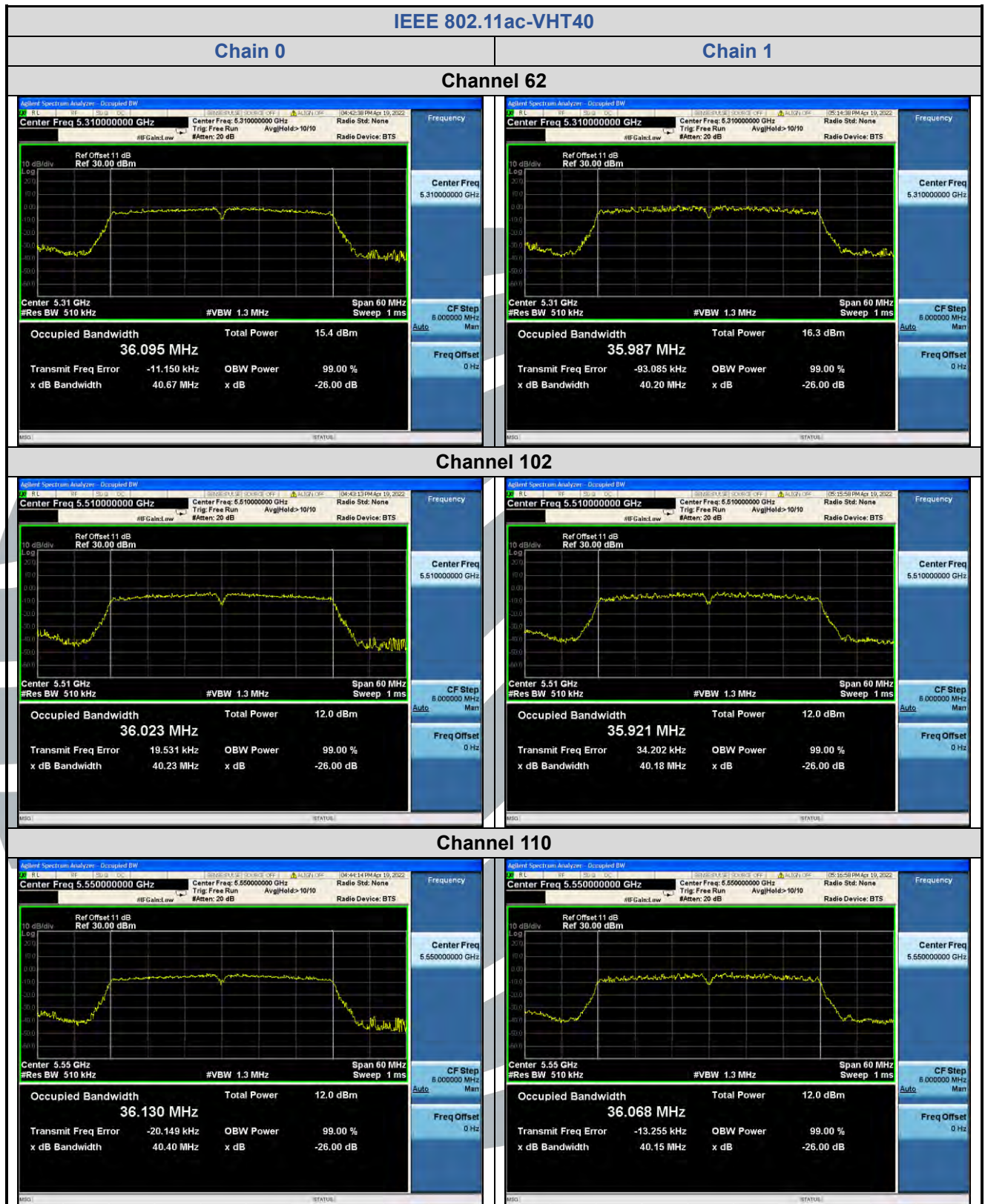
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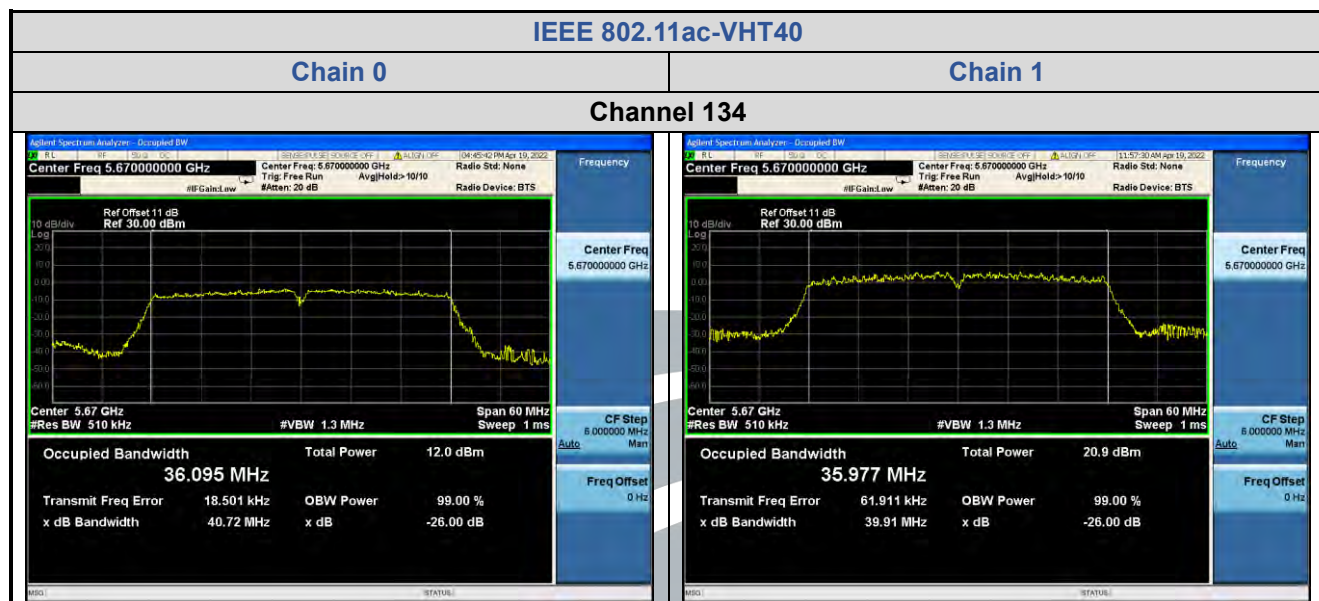


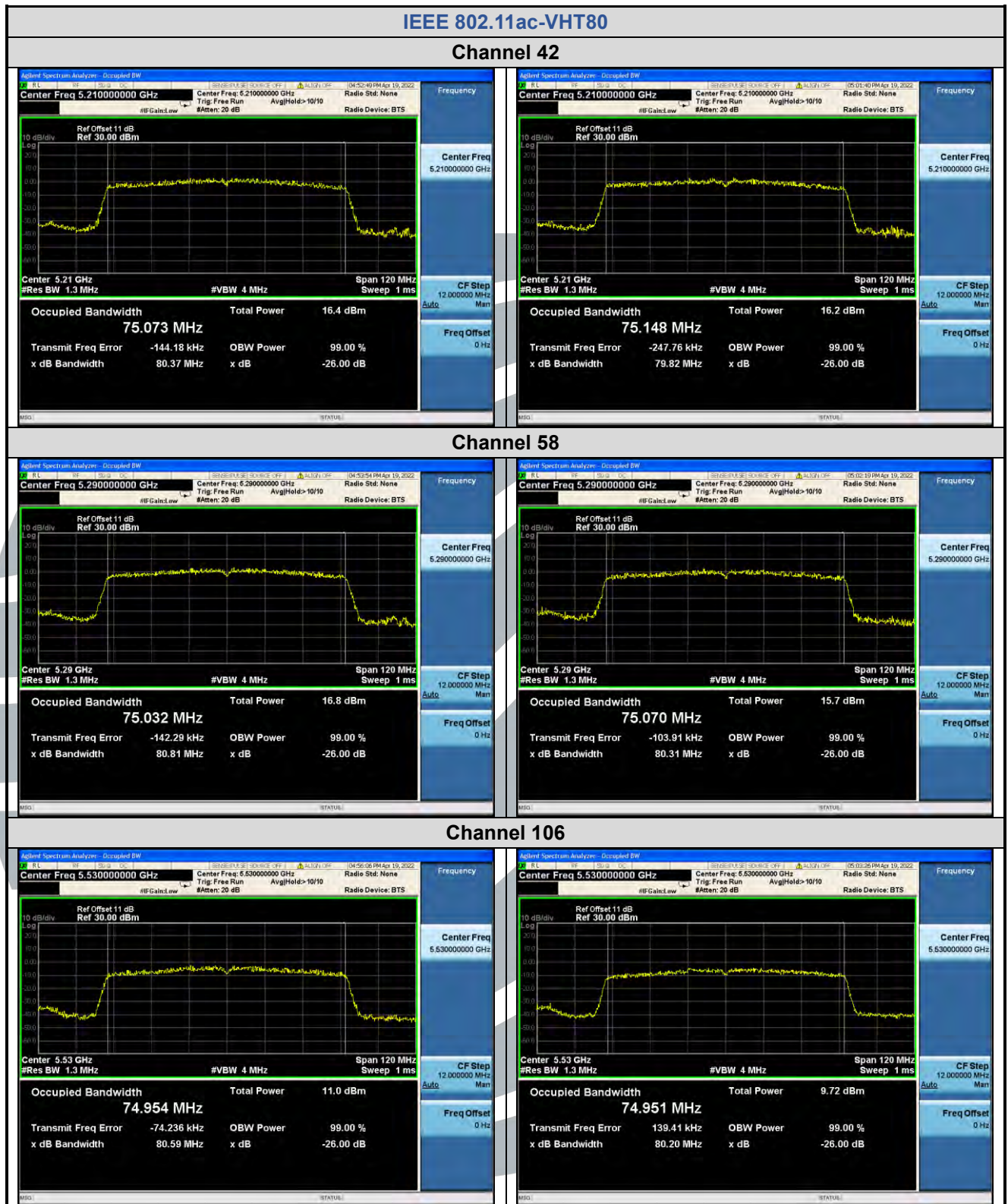












5.46 DB BANDWIDTH & OCCUPIED BANDWIDTH

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (e)
RSS-247 Issue 2 Section 6.2.4.1

Test Method: KDB 789033 D02 v02r01 Section C.2

Limit: Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

Test Procedure:

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer.

Spectrum analyzer according to the following Settings:

6dB Bandwidth

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW) $\geq 3 * \text{RBW}$.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Occupied Bandwidth

- a) Set RBW = 1% to 5% of the occupied bandwidth
- b) Set the video bandwidth (VBW) $\geq 3 \times \text{RBW}$.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: Pass

Test Data:

Mode	Channel/ Frequency (MHz)	6 dB Bandwidth (MHz)		99% Bandwidth (MHz)		6 dB Bandwidth Limit	Pass / Fail
		Chain 0	Chain 1	Chain 0	Chain 1		
IEEE 802.11a	149 (5745)	15.13	15.13	17.950	18.064	> 500 kHz	Pass
	157 (5785)	15.15	15.13	17.417	17.337	> 500 kHz	Pass
	165 (5825)	15.32	15.71	17.609	17.246	> 500 kHz	Pass
IEEE 802.11n- HT20	149 (5745)	15.71	15.72	17.887	17.778	> 500 kHz	Pass
	157 (5785)	15.71	15.69	17.852	17.808	> 500 kHz	Pass
	165 (5825)	15.68	15.10	17.880	17.829	> 500 kHz	Pass
IEEE 802.11n- HT40	151 (5755)	35.10	35.06	36.044	35.988	> 500 kHz	Pass
	159 (5795)	35.08	35.05	36.044	35.957	> 500 kHz	Pass
IEEE 802.11ac- VHT20	149 (5745)	15.13	15.12	17.784	17.760	> 500 kHz	Pass
	157 (5785)	15.11	15.13	17.848	17.866	> 500 kHz	Pass
	165 (5825)	15.68	15.11	17.930	17.846	> 500 kHz	Pass
IEEE 802.11ac- VHT40	151 (5755)	35.06	35.05	36.002	35.932	> 500 kHz	Pass
	159 (5795)	35.09	35.04	36.113	36.033	> 500 kHz	Pass
IEEE 802.11ac- VHT80	155 (5775)	73.83	63.86	75.210	74.706	> 500 kHz	Pass

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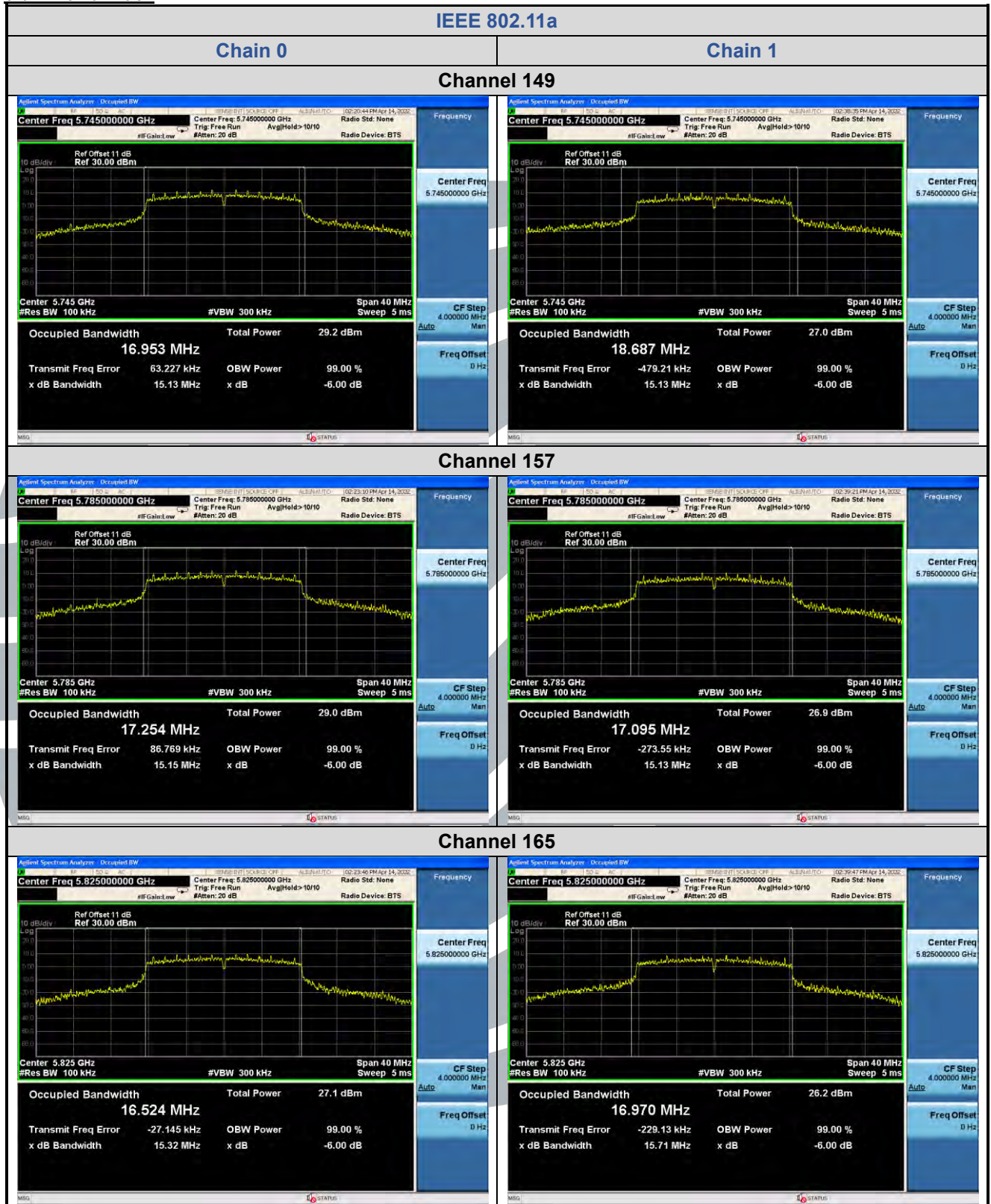
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The test plots as follows:

6 dB Bandwidth



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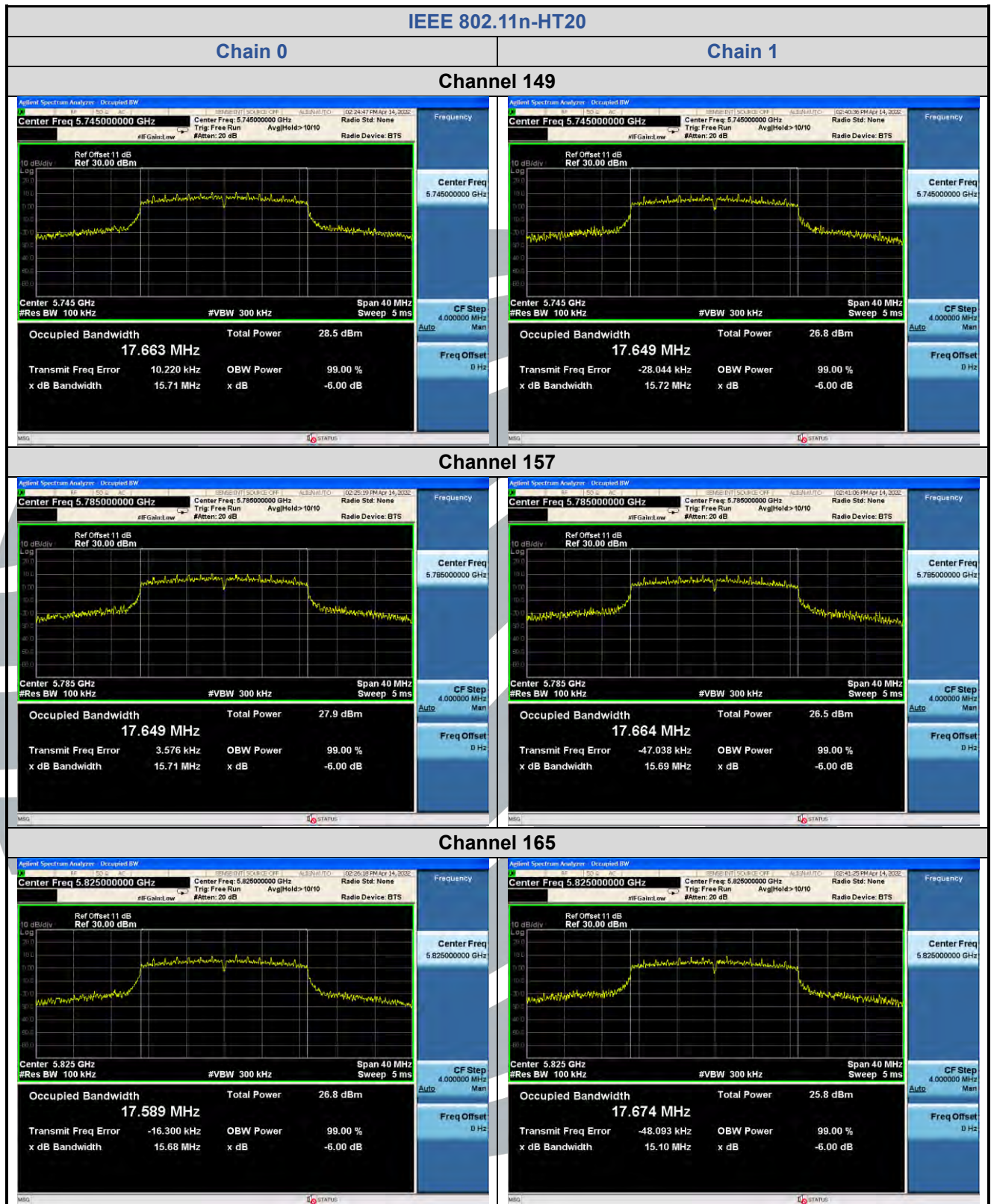
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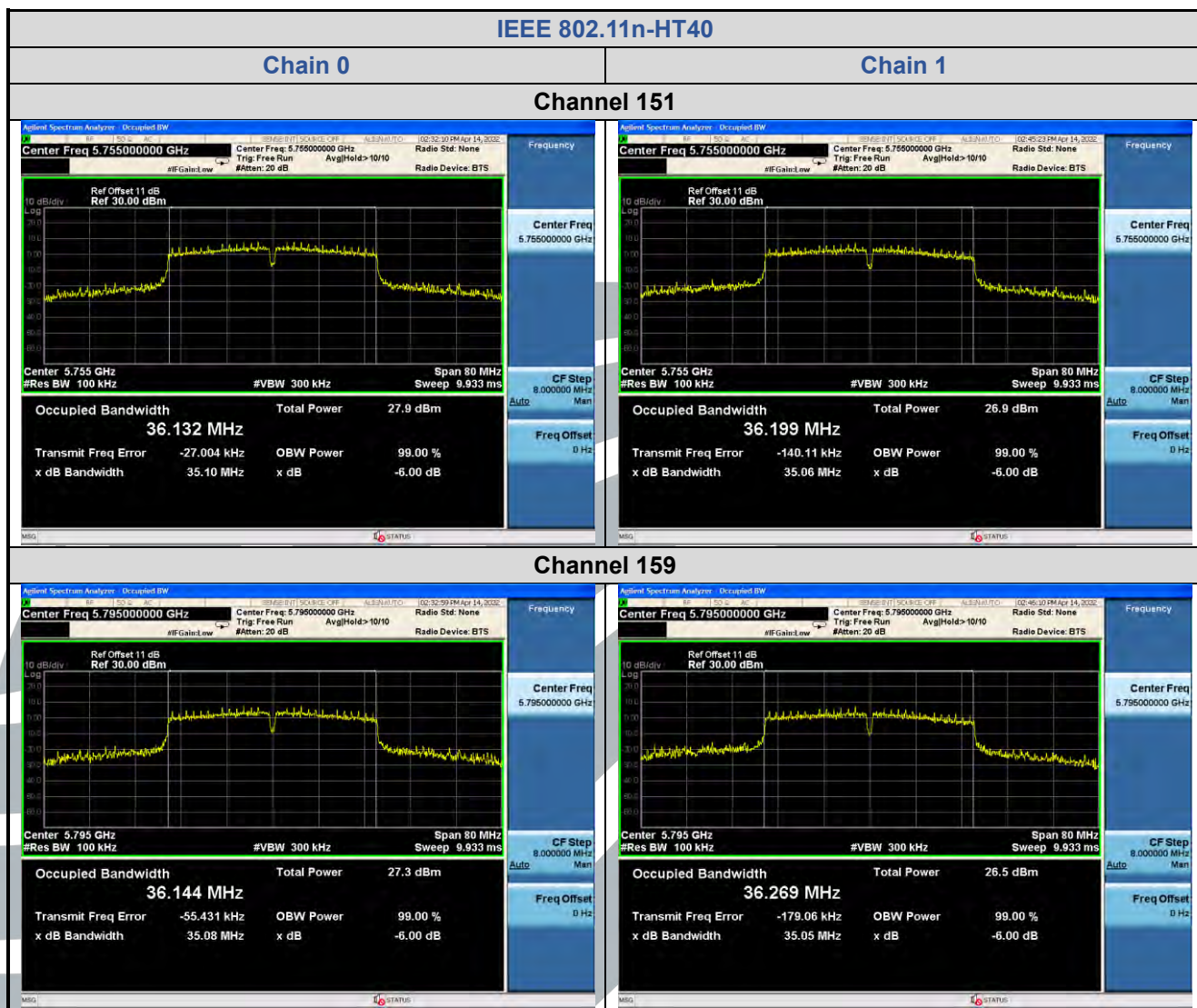
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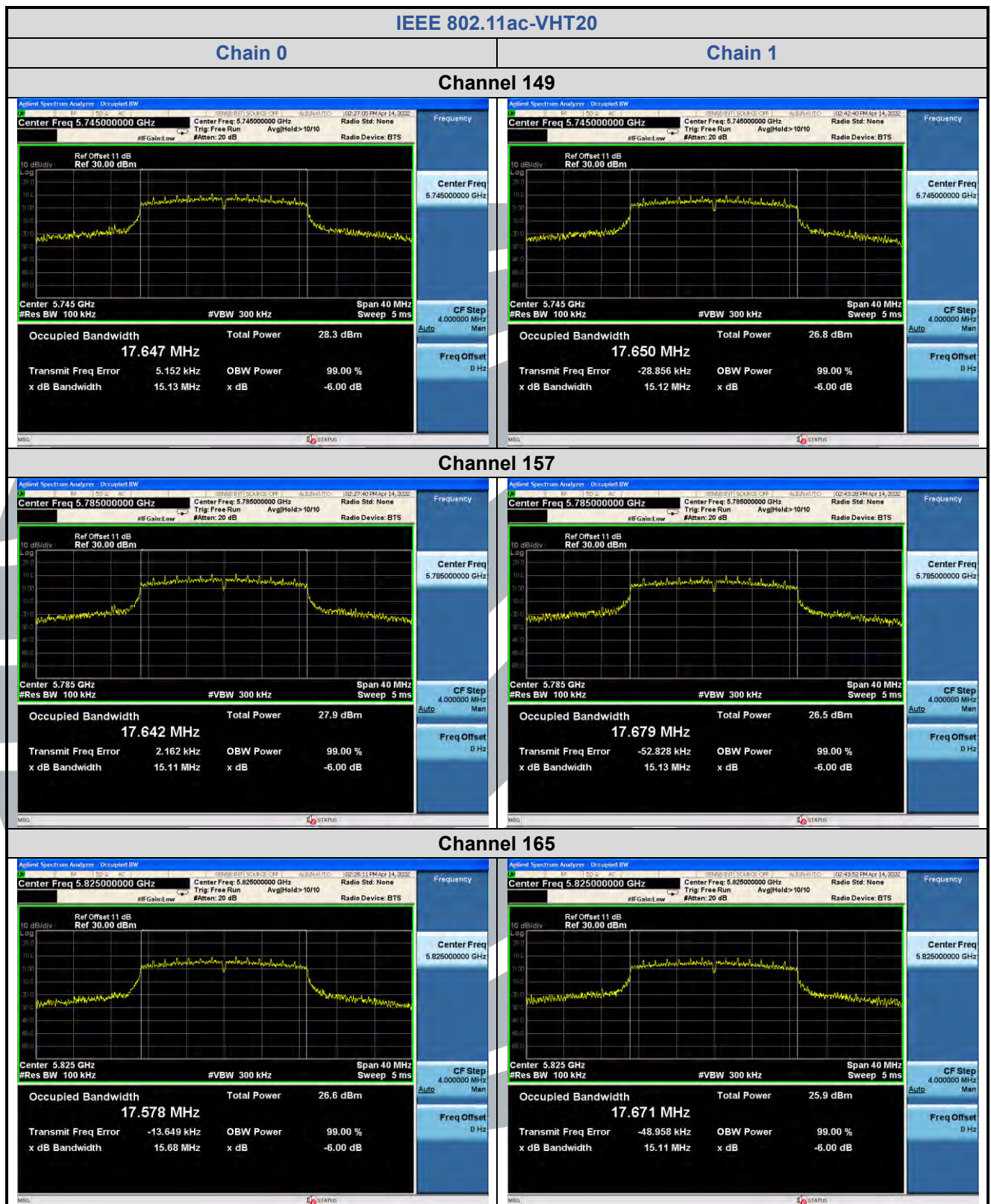
E-mail: info@uttlab.com

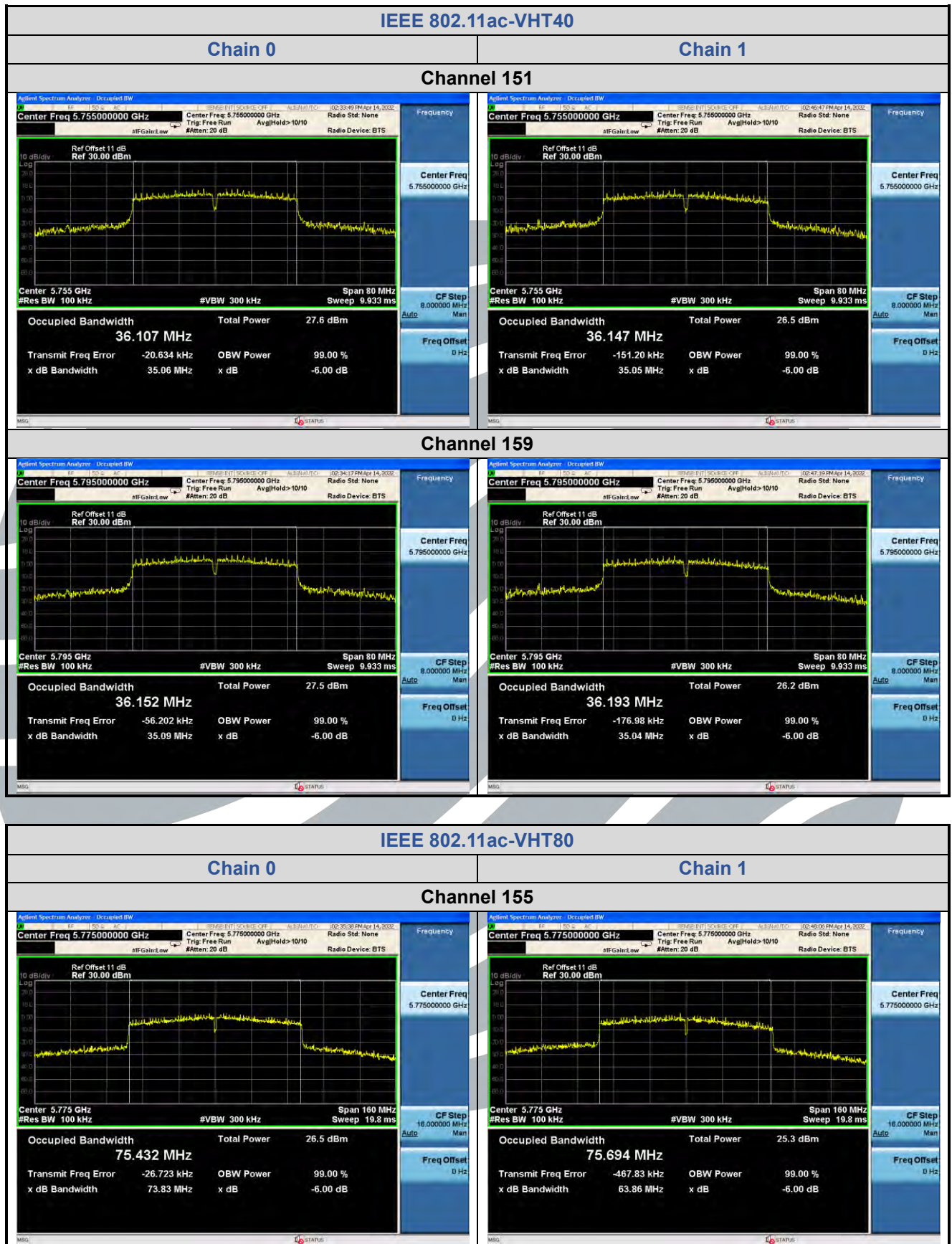
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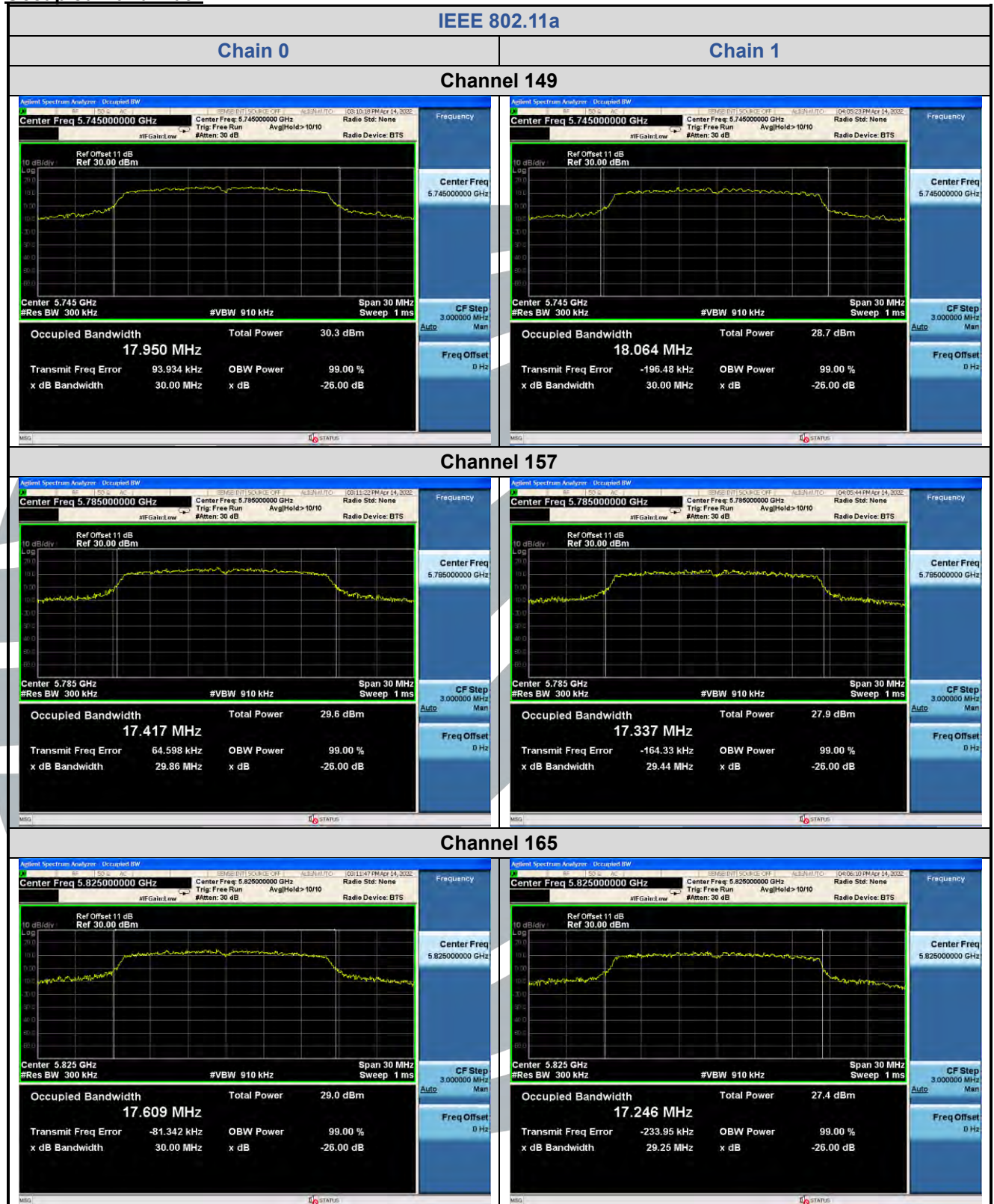


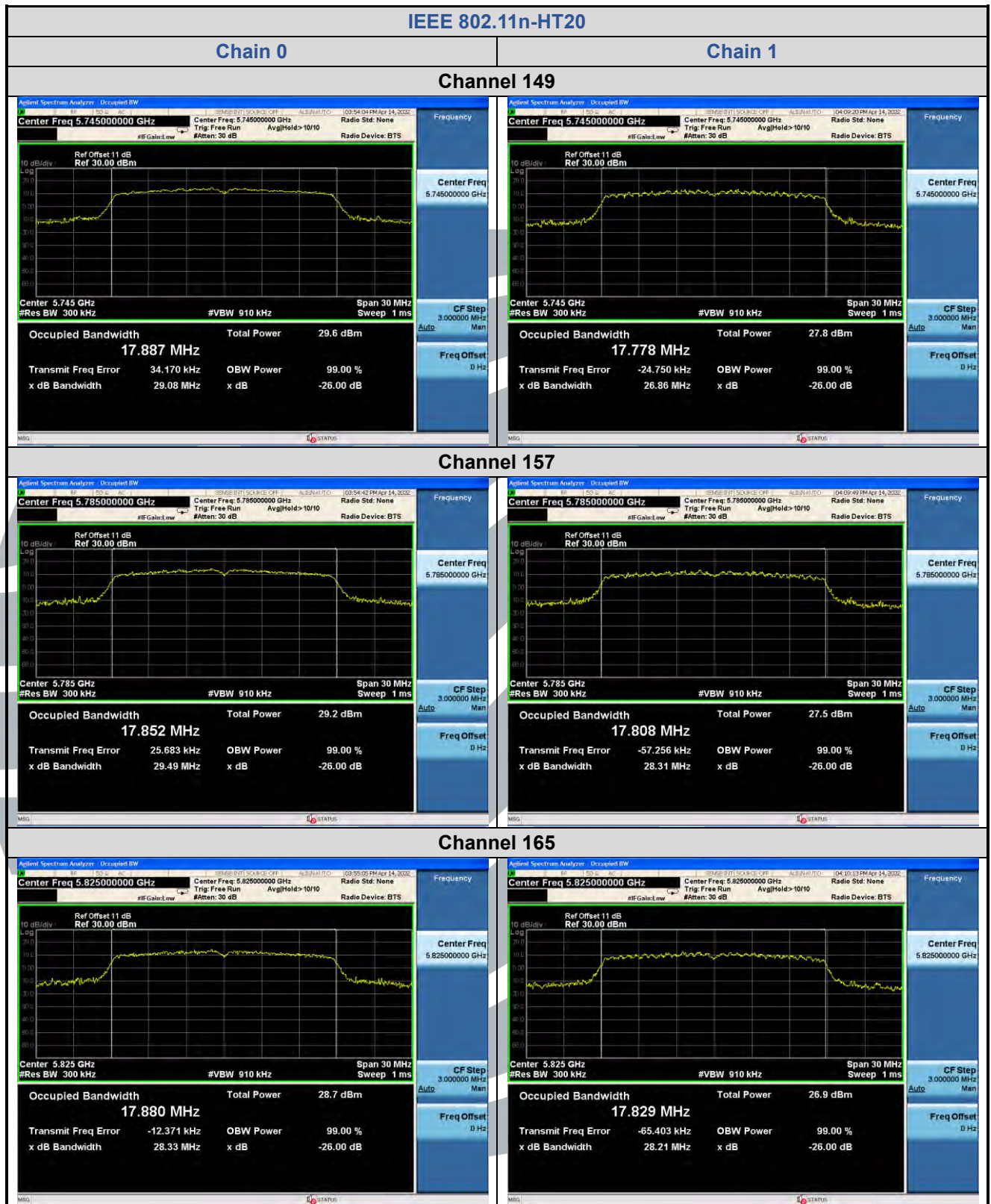


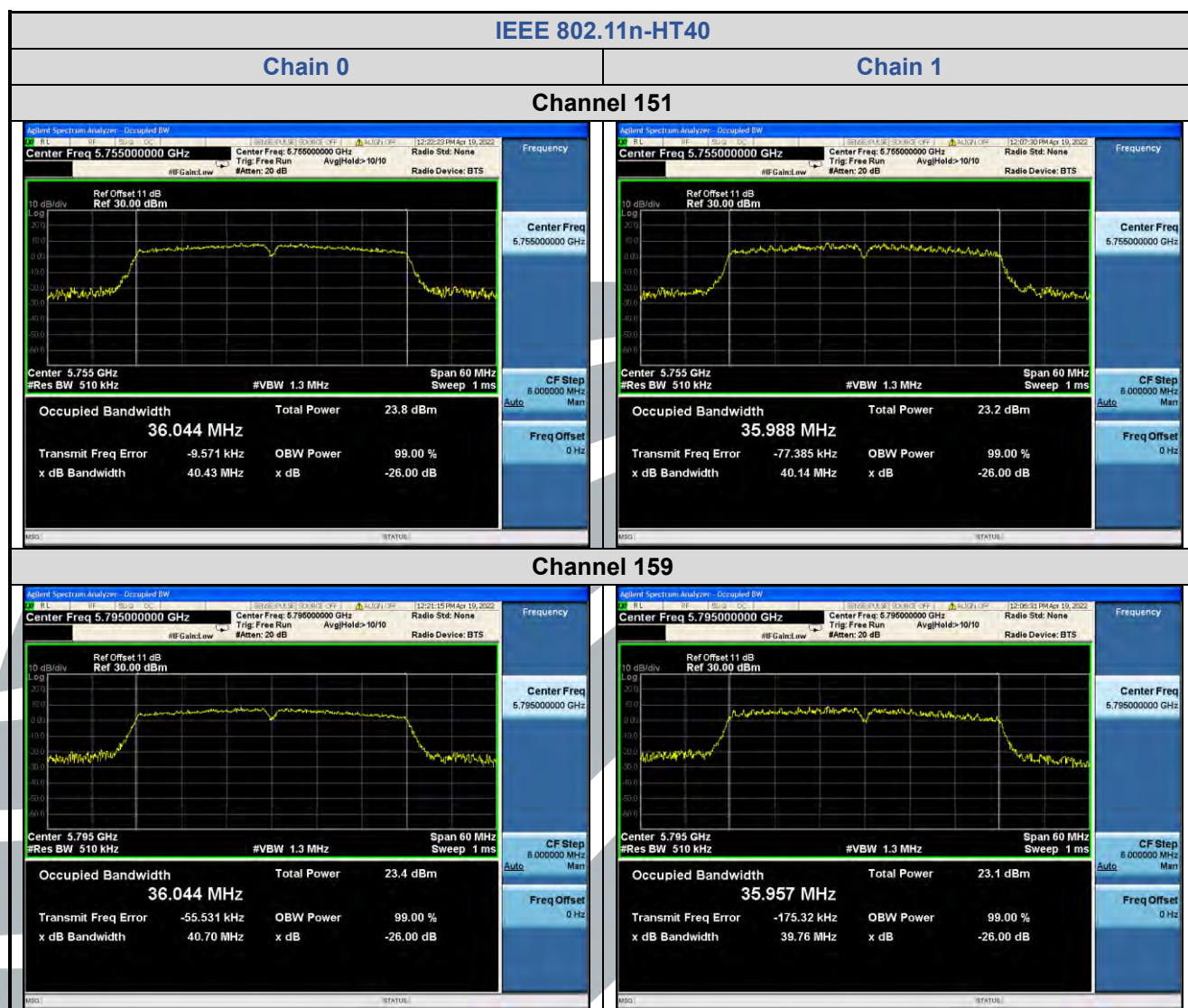


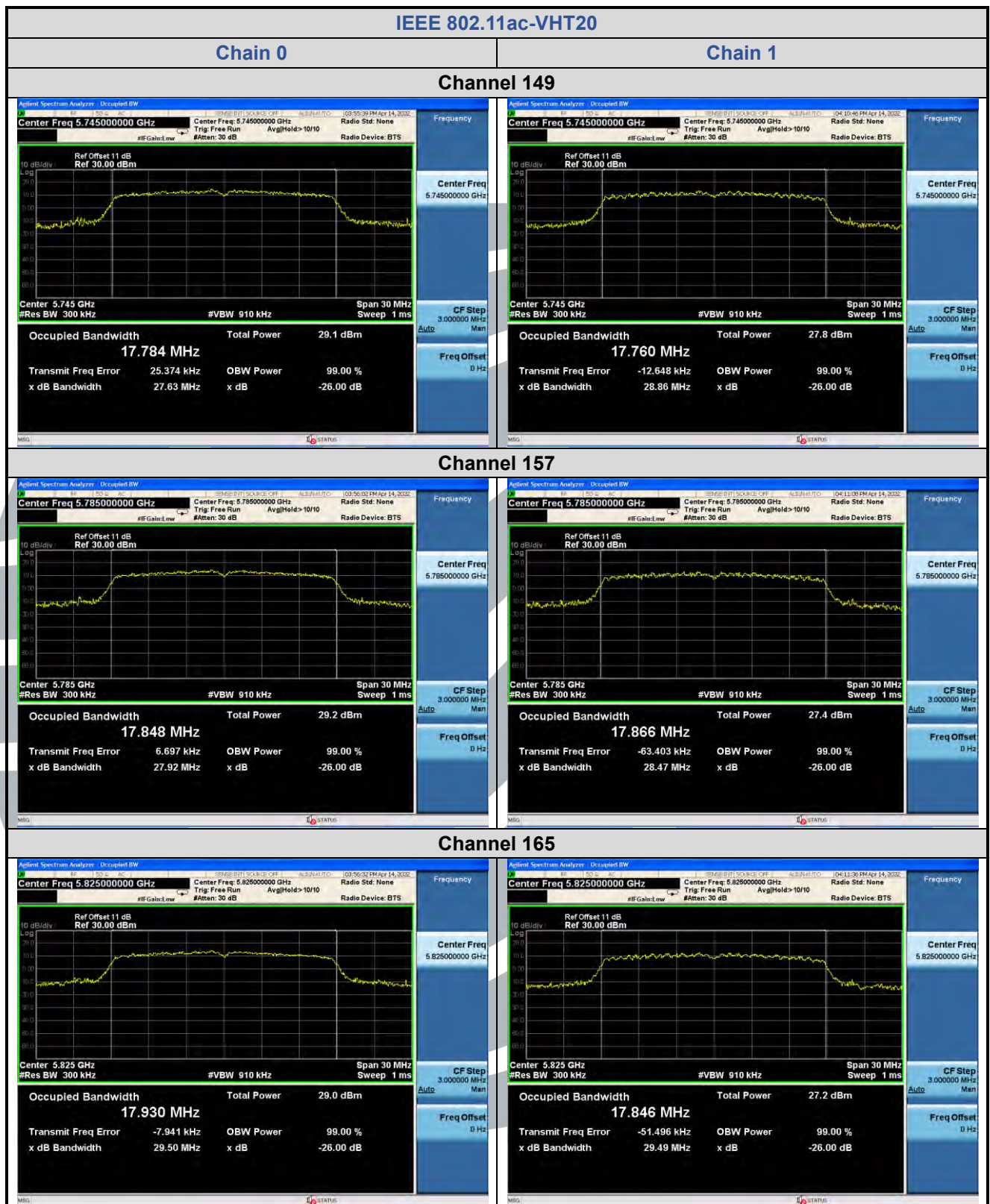


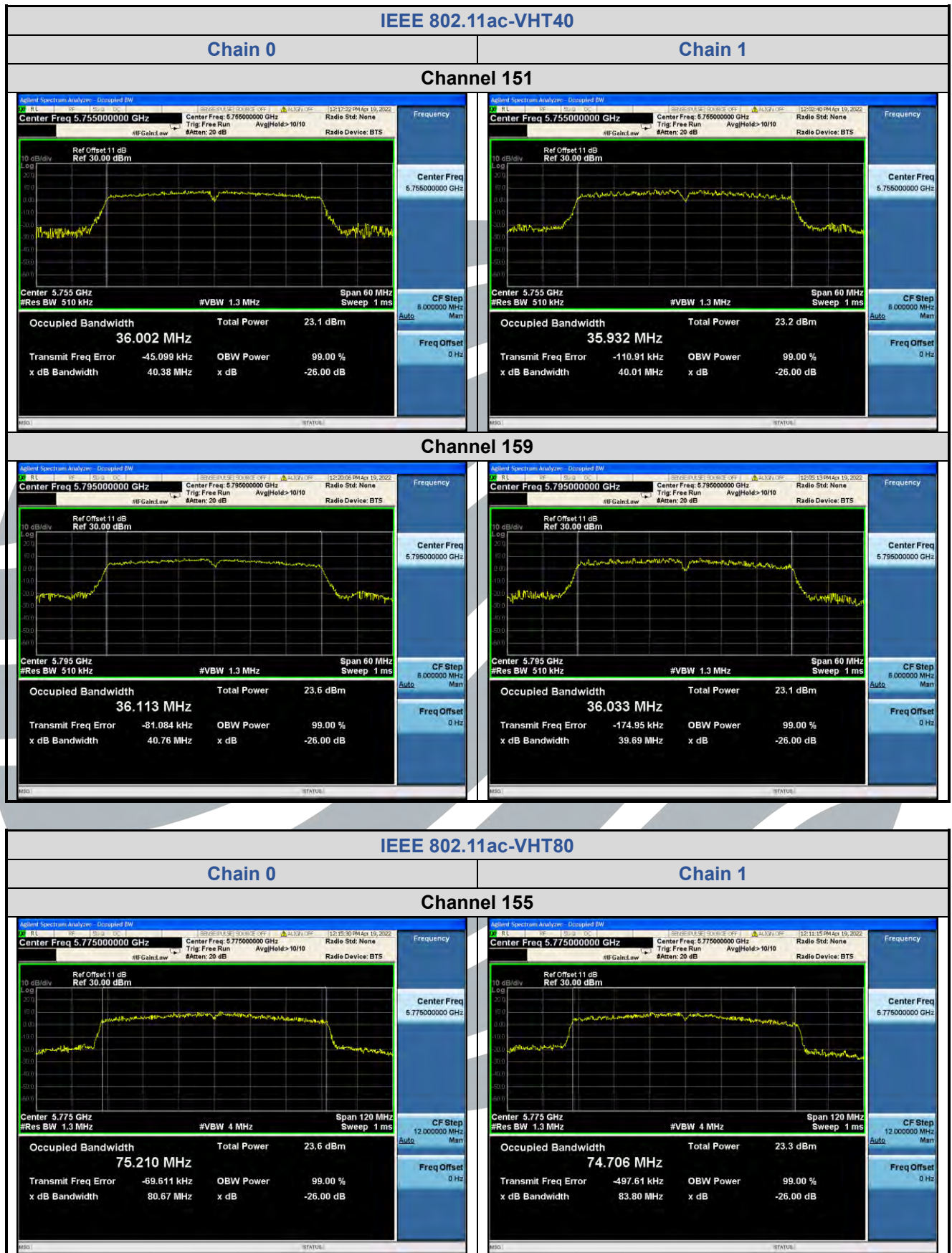
Occupied Bandwidth











5.5 MAXIMUM CONDUCTED OUTPUT POWER OR E.I.R.P

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)
RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1

Test Method: KDB 789033 D02 v02r01 Section E.3.a (Method PM)

Limits: FCC 47 CFR Part 15 Subpart E

1. For the band 5.15-5.25 GHz.
 - (i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).
 - (ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
 - (iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.
 - (iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
2. For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
3. For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

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UTTR-RF-RSS247-V1.1

Limits: RSS-247 Issue 2

1. Frequency band 5150-5250 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10 \log_{10} B$, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

For other devices, the maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

2. Frequency band 5250-5350 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10 \log_{10} B$, dBm, whichever is less. Devices shall implement TPC in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

Devices, other than devices installed in vehicles, shall comply with the following:

- a) The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10} B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band;
- b) The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

Additional requirements

In addition to the above requirements, devices shall comply with the following, where applicable:

- a) Outdoor fixed devices with a maximum e.i.r.p. greater than 200 mW shall comply with the following e.i.r.p. at different elevations, where θ is the angle above the local horizontal plane (of the Earth) as shown below:

i. -13 dBW/MHz	for $0^\circ \leq \theta < 8^\circ$
ii. $-13 - 0.716 (\theta - 8)$ dBW/MHz	for $8^\circ \leq \theta < 40^\circ$
iii. $-35.9 - 1.22 (\theta - 40)$ dBW/MHz	for $40^\circ \leq \theta \leq 45^\circ$
iv. -42 dBW/MHz	for $\theta > 45^\circ$

The measurement procedure defined in Annex A of this document shall be used to verify the compliance to the e.i.r.p. at different elevations.

- b) Devices, other than outdoor fixed devices, having an e.i.r.p. greater than 200 mW shall comply with either i. or ii. below:
 - i. devices shall comply with the e.i.r.p. elevation mask in 6.2.2.3(a); or
 - ii. devices shall implement a method to permanently reduce their e.i.r.p. via a firmware feature in the event that the Department requires it. The test report must demonstrate how the device's power table can be updated to meet this firmware requirement. The manufacturer shall provide this firmware to update all systems automatically in compliance with the directions received from the Department.

3. Frequency bands 5470-5600 MHz and 5650-5725 MHz

The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10} B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

4. Frequency band 5725-5850 MHz

The maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices

operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint³ systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

Test Procedure:

1. Connected the EUT's antenna port to measure device by 10dB attenuator.
2. Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of Tx on burst.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: Pass

Test Data:

Directional gain and the maximum output power limit.
RSS-247 Issue 2

Frequency Band	Chain 1 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	Peak Power Limits (dBm)
U-NII-1	5.00	5.00	5.00	23.00
U-NII-2A	5.00	5.00	5.00	24.00
U-NII-2C	5.00	5.00	5.00	24.00
U-NII-3	5.00	5.00	5.00	30.00

All antennas have the same gain, G_{ANT} , Directional gain = G_{ANT} + Array Gain, where Array Gain is 0 dB.

FCC 47 CFR Part 15 Subpart E

Frequency Band	Chain 1 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	Peak Power Limits (dBm)
U-NII-1	5.00	5.00	5.00	30.00
U-NII-2A	5.00	5.00	5.00	24.00
U-NII-2C	5.00	5.00	5.00	24.00
U-NII-3	5.00	5.00	5.00	30.00

All antennas have the same gain, G_{ANT} , Directional gain = G_{ANT} + Array Gain, where Array Gain is 0 dB.

Frequency band 5150-5250 MHz

RSS-247 Issue 2:

For IEEE 802.11 a, the minimum 99% emission bandwidth is 16.560 MHz

$$10 \text{ dBm} + 10\log_{10}(16.560) = 22.19 \text{ dBm} < 23 \text{ dBm}$$

So the 22.19 dB limit applicable

For IEEE 802.11 n-HT20/ac-VHT20, the minimum 99% emission bandwidth is 17.571MHz

$$10 \text{ dBm} + 10\log_{10}(17.571) = 22.45 \text{ dBm} < 23 \text{ dBm}$$

So the 22.45 dB limit applicable

For IEEE 802.11 n-HT40/ac-VHT40/ac-VHT80, the minimum 99% emission bandwidth is 35.914 MHz

$$10 \text{ dBm} + 10\log_{10}(35.914) = 25.55 \text{ dBm} > 23 \text{ dBm}$$

So the 23 dB limit applicable

Mode	Channel/ Frequency (MHz)	Maximum e.i.r.p (dBm)		Total e.i.r.p MIMO_ Chain 0+1 (dBm)	Limit (dBm)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	36 (5180)	18.39	17.16	N/A	22.19	Pass
	44 (5220)	18.37	16.53	N/A	22.19	Pass
	48 (5240)	18.33	16.62	N/A	22.19	Pass
IEEE 802.11n-HT20	36 (5180)	13.25	12.44	15.88	22.45	Pass
	44 (5220)	13.20	11.92	15.62	22.45	Pass
	48 (5240)	13.22	11.91	15.63	22.45	Pass
IEEE 802.11n-HT40	38 (5190)	17.01	16.64	19.83	23	Pass
	46 (5230)	16.95	16.29	19.64	23	Pass
IEEE 802.11ac-VHT20	36 (5180)	13.38	12.48	15.96	22.45	Pass
	44 (5220)	13.29	12.09	15.74	22.45	Pass
	48 (5240)	13.38	12.06	15.78	22.45	Pass
IEEE 802.11ac-VHT40	38 (5190)	17.22	16.88	20.06	23	Pass
	46 (5230)	17.20	16.58	19.91	23	Pass
IEEE 802.11ac-VHT80	42 (5210)	18.17	16.82	20.55	23	Pass

Remark:

1. Maximum e.i.r.p = Maximum conducted output power + Antenna Gain
2. Total e.i.r.p (Chain 0+1) = $10 \cdot \log_{10}[(10^{\text{Chain 0}/10}) + (10^{\text{Chain 1}/10})] + \text{Directional gain}$
3. The maximum EIRP is calculated from max output power and antenna gain, the antenna gain provided by the customer, and the customer takes all the responsibilities for the accuracy of antenna gain.

FCC 47 CFR Part 15 Subpart E:

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)		Total Power MIMO_ Chain 0+1 (dBm)	Limit (dBm)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	36 (5180)	19.00	17.82	N/A	30	Pass
	44 (5220)	19.05	17.40	N/A	30	Pass
	48 (5240)	19.05	17.34	N/A	30	Pass
IEEE 802.11n-HT20	36 (5180)	16.79	15.36	19.15	30	Pass
	44 (5220)	16.77	14.86	18.93	30	Pass
	48 (5240)	16.83	14.78	18.94	30	Pass
IEEE 802.11n-HT40	38 (5190)	15.75	14.64	18.24	30	Pass
	46 (5230)	15.81	14.19	18.08	30	Pass
IEEE 802.11ac-VHT20	36 (5180)	17.02	15.50	19.33	30	Pass
	44 (5220)	16.99	15.02	19.12	30	Pass
	48 (5240)	17.00	15.06	19.15	30	Pass
IEEE 802.11ac-VHT40	38 (5190)	16.01	14.84	18.47	30	Pass
	46 (5230)	15.97	14.36	18.25	30	Pass
IEEE 802.11ac-VHT80	42 (5210)	13.17	11.82	15.55	30	Pass

Remark:

- Maximum conducted output power = Conducted output power + Duty Cycle Factor
- Total Power (Chain 0+1) = $10 \cdot \log[(10^{\text{Chain 0}/10}) + (10^{\text{Chain 1}/10})]$

Frequency band 5250-5350 MHz

RSS-247 Issue 2:

For IEEE 802.11 a/n-HT20/ac-VHT20, the minimum 99% emission bandwidth is 16.415 MHz

$$11 \text{ dBm} + 10\log_{10}(16.415) = 23.15 \text{ dBm}$$

$$23.15 \text{ dBm} < 24 \text{ dBm}$$

So the 23.15 dB limit applicable

For IEEE 802.11 n-HT40/ac-VHT40/ac-VHT80, the minimum 99% emission bandwidth is 35.987 MHz

$$11 \text{ dBm} + 10\log_{10}(35.987) = 26.56 \text{ dBm} > 24 \text{ dBm}$$

So the 24 dB limit applicable

FCC 47 CFR Part 15 Subpart E:

For IEEE 802.11 a/n/ac, the minimum 26 dB emission bandwidth is 19.50 MHz

$$11 \text{ dBm} + 10\log_{10}(19.50) = 23.90 \text{ dBm} < 24 \text{ dBm}$$

So the 23.90 dB limit applicable

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)		Total Power MIMO_ Chain 0+1 (dBm)	Limit (dBm)		Pass / Fail
		SISO			FCC Part 15E	RSS- 247	
		Chain 0	Chain 1				
IEEE 802.11a	52 (5260)	18.83	17.41	N/A	23.90	23.15	Pass
	60 (5300)	19.00	17.25	N/A	23.90	23.15	Pass
	64 (5320)	19.20	17.40	N/A	23.90	23.15	Pass
IEEE 802.11n- HT20	52 (5260)	14.14	12.49	16.41	23.90	23.15	Pass
	60 (5300)	14.34	12.30	16.45	23.90	23.15	Pass
	64 (5320)	14.39	12.47	16.55	23.90	23.15	Pass
IEEE 802.11n- HT40	54 (5270)	15.64	14.21	17.99	23.90	24	Pass
	62 (5310)	15.82	14.04	18.03	23.90	24	Pass
IEEE 802.11ac- VHT20	52 (5260)	14.34	12.64	16.58	23.90	23.15	Pass
	60 (5300)	14.52	12.45	16.62	23.90	23.15	Pass
	64 (5320)	14.62	12.71	16.78	23.90	23.15	Pass
IEEE 802.11ac- VHT40	54 (5270)	15.92	14.38	18.23	23.90	24	Pass
	62 (5310)	15.97	14.25	18.20	23.90	24	Pass
IEEE 802.11ac- VHT80	58 (5290)	13.14	11.63	15.46	23.90	24	Pass
Remark: 1. Maximum conducted output power = Conducted output power + Duty Cycle Factor 2. Total Power (Chain 0+1) = $10 \cdot \log[(10^{\text{Chain 0}/10})+(10^{\text{Chain 1}/10})]$							

Frequency band 5250-5350 MHz

RSS-247 Issue 2:

For IEEE 802.11 a/n-HT20/ac-VHT20, the minimum 99% emission bandwidth is 16.415 MHz

$$17 \text{ dBm} + 10\log_{10}(16.415) = 29.15 \text{ dBm}$$

$$29.15 \text{ dBm} < 30 \text{ dBm}$$

So the 29.15 dB limit applicable

For IEEE 802.11 n-HT40/ac-VHT40/ac-VHT80, the minimum 99% emission bandwidth is 35.987 MHz

$$17 \text{ dBm} + 10\log_{10}(35.987) = 32.56 \text{ dBm} > 30 \text{ dBm}$$

So the 30 dB limit applicable

Mode	Channel/ Frequency (MHz)	Maximum e.i.r.p (dBm)		Total e.i.r.p MIMO_ Chain 0+1 (dBm)	Limit (dBm)	Pass / Fail
		SISO			RSS-247	
		Chain 0	Chain 1			
IEEE 802.11a	52 (5260)	23.83	22.41	N/A	29.15	Pass
	60 (5300)	24.00	22.25	N/A	29.15	Pass
	64 (5320)	24.20	22.40	N/A	29.15	Pass
IEEE 802.11n- HT20	52 (5260)	19.14	17.49	21.41	29.15	Pass
	60 (5300)	19.34	17.30	21.45	29.15	Pass
	64 (5320)	19.39	17.47	21.55	29.15	Pass
IEEE 802.11n- HT40	54 (5270)	20.64	19.21	22.99	30	Pass
	62 (5310)	20.82	19.04	23.03	30	Pass
IEEE 802.11ac- VHT20	52 (5260)	19.34	17.64	21.58	29.15	Pass
	60 (5300)	19.52	17.45	21.62	29.15	Pass
	64 (5320)	19.62	17.71	21.78	29.15	Pass
IEEE 802.11ac- VHT40	54 (5270)	20.92	19.38	23.23	30	Pass
	62 (5310)	20.97	19.25	23.20	30	Pass
IEEE 802.11ac- VHT80	58 (5290)	18.14	16.63	20.46	30	Pass

Remark:

1. Maximum e.i.r.p = Maximum conducted output power + Antenna Gain

2. Total e.i.r.p (Chain 0+1) = $10 \cdot \log[(10^{\text{Chain 0}/10}) + (10^{\text{Chain 1}/10})]$ + Directional gain

3. The maximum EIRP is calculated from max output power and antenna gain, the antenna gain provided by the customer, and the customer takes all the responsibilities for the accuracy of antenna gain.

Frequency bands 5470-5725 MHz (RSS-247 Issue 2 Not including 5600-5650 MHz)

RSS-247 Issue 2:

For IEEE 802.11 a/n-HT20/ac-VHT20, the minimum 99% emission bandwidth is 16.426 MHz

$$11 \text{ dBm} + 10\log_{10}(16.426) = 23.16 \text{ dBm}$$

$$23.16 \text{ dBm} < 24 \text{ dBm}$$

So the 23.16 dB limit applicable

For IEEE 802.11 n-HT40/ac-VHT40 /ac-VHT80, the minimum 99% emission bandwidth is 35.921 MHz

$$11 \text{ dBm} + 10\log_{10}(35.921) = 26.55 \text{ dBm} > 24 \text{ dBm}$$

So the 24 dB limit applicable

FCC 47 CFR Part 15 Subpart E:

For IEEE 802.11 a/n/ac, the minimum 26 dB emission bandwidth is 19.56 MHz

$$11 \text{ dBm} + 10\log_{10}(19.56) = 23.91 \text{ dBm} < 24 \text{ dBm}$$

So the 23.91 dB limit applicable

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)		Total Power MIMO_ Chain 0+1 (dBm)	Limit (dBm)		Pass / Fail
		SISO			FCC Part 15E	RSS- 247	
		Chain 0	Chain 1				
IEEE 802.11a	100 (5500)	16.52	14.59	N/A	23.91	23.16	Pass
	116 (5580)	16.16	14.15	N/A	23.91	23.16	Pass
	140 (5700)	16.30	14.53	N/A	23.91	23.16	Pass
IEEE 802.11n- HT20	100 (5500)	14.13	12.09	16.24	23.91	23.16	Pass
	116 (5580)	13.71	11.56	15.78	23.91	23.16	Pass
	140 (5700)	13.73	11.96	15.95	23.91	23.16	Pass
IEEE 802.11n- HT40	102 (5510)	14.59	12.64	16.73	23.91	24	Pass
	110 (5550)	14.34	12.37	16.47	23.91	24	Pass
	134 (5670)	14.06	13.30	16.70	23.91	24	Pass
IEEE 802.11ac- VHT20	100 (5500)	14.32	12.26	16.42	23.91	23.16	Pass
	116 (5580)	13.86	11.76	15.94	23.91	23.16	Pass
	140 (5700)	13.84	12.03	16.04	23.91	23.16	Pass
IEEE 802.11ac- VHT40	102 (5510)	14.86	12.78	16.95	23.91	24	Pass
	110 (5550)	14.60	12.61	16.73	23.91	24	Pass
	134 (5670)	14.37	13.56	16.99	23.91	24	Pass
IEEE 802.11ac- VHT80	106 (5530)	11.35	9.78	13.64	23.91	24	Pass

Remark:

- Maximum conducted output power = Conducted output power + Duty Cycle Factor
- Total Power (Chain 0+1) = $10 \cdot \log_{10}[(10^{\text{Chain 0}/10}) + (10^{\text{Chain 1}/10})]$

Frequency bands 5470-5725 MHz (RSS-247 Issue 2 Not including 5600-5650 MHz)
RSS-247 Issue 2:

For IEEE 802.11 a/n-HT20/ac-VHT20, the minimum 99% emission bandwidth is 16.426 MHz

$17 \text{ dBm} + 10\log_{10}(16.426) = 29.16 \text{ dBm}$

$29.16 \text{ dBm} < 30 \text{ dBm}$

So the 29.16 dB limit applicable

For IEEE 802.11 n-HT40/ac-VHT40 /ac-VHT80, the minimum 99% emission bandwidth is 35.921 MHz

$17 \text{ dBm} + 10\log_{10}(35.921) = 32.55 \text{ dBm} > 30 \text{ dBm}$

So the 30 dB limit applicable

Mode	Channel/ Frequency (MHz)	Maximum e.i.r.p (dBm)		Total e.i.r.p MIMO_ Chain 0+1 (dBm)	Limit (dBm)	Pass / Fail
		SISO			RSS-247	
		Chain 0	Chain 1			
IEEE 802.11a	100 (5500)	21.52	19.59	N/A	29.16	Pass
	116 (5580)	21.16	19.15	N/A	29.16	Pass
	140 (5700)	21.30	19.53	N/A	29.16	Pass
IEEE 802.11n- HT20	100 (5500)	19.13	17.09	21.24	29.16	Pass
	116 (5580)	18.71	16.56	20.78	29.16	Pass
	140 (5700)	18.73	16.96	20.95	29.16	Pass
IEEE 802.11n- HT40	102 (5510)	19.59	17.64	21.73	30	Pass
	110 (5550)	19.34	17.37	21.47	30	Pass
	134 (5670)	19.06	18.30	21.70	30	Pass
IEEE 802.11ac- VHT20	100 (5500)	19.32	17.26	21.42	29.16	Pass
	116 (5580)	18.86	16.76	20.94	29.16	Pass
	140 (5700)	18.84	17.03	21.04	29.16	Pass
IEEE 802.11ac- VHT40	102 (5510)	19.86	17.78	21.95	30	Pass
	110 (5550)	19.60	17.61	21.73	30	Pass
	134 (5670)	19.37	18.56	21.99	30	Pass
IEEE 802.11ac- VHT80	106 (5530)	16.35	14.78	18.64	30	Pass

Remark:

1. Maximum e.i.r.p = Maximum conducted output power + Antenna Gain
2. Total e.i.r.p (Chain 0+1) = $10 \cdot \log_{10}[(10^{\text{Chain 0}/10}) + (10^{\text{Chain 1}/10})] + \text{Directional gain}$
3. The maximum EIRP is calculated from max output power and antenna gain, the antenna gain provided by the customer, and the customer takes all the responsibilities for the accuracy of antenna gain.

Frequency band 5725-5850 MHz

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)		Total Power MIMO_ Chain 0+1 (dBm)	Limit (dBm)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	149 (5745)	19.81	18.15	N/A	30	Pass
	157 (5785)	19.85	18.22	N/A	30	Pass
	165 (5825)	19.57	17.80	N/A	30	Pass
IEEE 802.11n-HT20	149 (5745)	18.86	17.28	21.15	30	Pass
	157 (5785)	18.97	17.26	21.21	30	Pass
	165 (5825)	18.84	16.88	20.98	30	Pass
IEEE 802.11n-HT40	151 (5755)	18.85	17.42	21.20	30	Pass
	159 (5795)	18.83	17.38	21.17	30	Pass
IEEE 802.11ac-VHT20	149 (5745)	19.15	17.50	21.41	30	Pass
	157 (5785)	19.19	17.49	21.43	30	Pass
	165 (5825)	18.94	17.09	21.12	30	Pass
IEEE 802.11ac-VHT40	151 (5755)	18.94	17.69	21.37	30	Pass
	159 (5795)	19.07	17.57	21.39	30	Pass
IEEE 802.11ac-VHT80	155 (5775)	18.84	17.46	21.21	30	Pass
Remark:						
1. Maximum conducted output power = Conducted output power + Duty Cycle Factor						
2. Total Power(Chain 0+1) = 10*log[(10 ^{Chain 0/10})+(10 ^{Chain 1/10})]						

5.6 PEAK POWER SPECTRAL DENSITY

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)
RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1

Test Method: KDB 789033 D02 v02r01 Section F

Limits: FCC 47 CFR Part 15 Subpart E

1. For the band 5.15-5.25 GHz.
 - (i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).
 - (ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
 - (iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.
 - (iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
2. For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
3. For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

Limits: RSS-247 Issue 2

1. Frequency band 5150-5250 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10 \log_{10} B$, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

For other devices, the maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

2. Frequency band 5250-5350 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10 \log_{10} B$, dBm, whichever is less. Devices shall implement TPC in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

Devices, other than devices installed in vehicles, shall comply with the following:

- a) The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10} B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band;
- b) The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

Additional requirements

In addition to the above requirements, devices shall comply with the following, where applicable:

- a) Outdoor fixed devices with a maximum e.i.r.p. greater than 200 mW shall comply with the following e.i.r.p. at different elevations, where θ is the angle above the local horizontal plane (of the Earth) as shown below:

i. -13 dBW/MHz	for $0^\circ \leq \theta < 8^\circ$
ii. $-13 - 0.716 (\theta - 8)$ dBW/MHz	for $8^\circ \leq \theta < 40^\circ$
iii. $-35.9 - 1.22 (\theta - 40)$ dBW/MHz	for $40^\circ \leq \theta \leq 45^\circ$
iv. -42 dBW/MHz	for $\theta > 45^\circ$

The measurement procedure defined in Annex A of this document shall be used to verify the compliance to the e.i.r.p. at different elevations.

- b) Devices, other than outdoor fixed devices, having an e.i.r.p. greater than 200 mW shall comply with either i. or ii. below:
 - iii. devices shall comply with the e.i.r.p. elevation mask in 6.2.2.3(a); or
 - iv. devices shall implement a method to permanently reduce their e.i.r.p. via a firmware feature in the event that the Department requires it. The test report must demonstrate how the device's power table can be updated to meet this firmware requirement. The manufacturer shall provide this firmware to update all systems automatically in compliance with the directions received from the Department.

3. Frequency bands 5470-5600 MHz and 5650-5725 MHz

The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10} B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

4. Frequency band 5725-5850 MHz

The maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices

operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint³ systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

Test Procedure:

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer.

Spectrum analyzer according to the following Settings:

1. For U-NII-1, U-NII-2A, U-NII-2C band:

Using method SA-2

- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 1 MHz, Set VBW $\geq$ 3 RBW, Detector = RMS
- Sweep time = auto, trigger set to "free run".
- Trace average at least 100 traces in power averaging mode.
- Record the max value and add 10 log (1/duty cycle)

2. For U-NII-3 band:

- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 500 kHz, Set VBW $\geq$ 3 RBW, Detector = RMS
- Use the peak marker function to determine the maximum power level in any 500 kHz band segment within the fundamental EBW.
- Sweep time = auto, trigger set to "free run".
- Trace average at least 100 traces in power averaging mode.
- Record the max value and add 10 log (1/duty cycle)

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: Pass

Test Data:

Directional gain and the maximum output power limit.

RSS-247 Issue 2:

Frequency Band	Chain 1 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	PSD Limits (dBm/MHz or dBm/500kHz)
U-NII-1	5.00	5.00	8.01	7.99
U-NII-2A	5.00	5.00	8.01	8.99
U-NII-2C	5.00	5.00	8.01	8.99
U-NII-3	5.00	5.00	8.01	27.99

Basic methodology with N_{ANT} transmit antennas, each with the same directional gain G_{ANT} dBi, being driven by N_{ANT} transmitter outputs of equal power. Directional gain is to be computed as follows:

If any transmit signals are *correlated* with each other,

$$\text{Directional gain} = G_{ANT} + 10 \log(N_{ANT}) \text{ dBi}$$

Remark:

If all antennas have the same gain, G_{ANT} , Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

For power spectral density (PSD) measurements on all devices,

Array Gain = $10 \log(N_{ANT}/N_{SS})$ dB.

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;

Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT} ; Array Gain = $5 \log(N_{ANT}/N_{SS})$ dB or 3 dB, whichever is less, for 20-MHz channel widths with $N_{ANT} \geq 5$.

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UTTR-RF-RSS247-V1.1

FCC 47 CFR Part 15 Subpart E:

Frequency Band	Chain 1 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	PSD Limits (dBm/MHz or dBm/500kHz)
U-NII-1	5.00	5.00	8.01	14.99
U-NII-2A	5.00	5.00	8.01	8.99
U-NII-2C	5.00	5.00	8.01	8.99
U-NII-3	5.00	5.00	8.01	27.99
Basic methodology with N_{ANT} transmit antennas, each with the same directional gain G_{ANT} dBi, being driven by N_{ANT} transmitter outputs of equal power. Directional gain is to be computed as follows:				
If any transmit signals are <i>correlated</i> with each other,				
Directional gain = $G_{ANT} + 10 \log(N_{ANT})$ dBi				

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UTTR-RF-RSS247-V1.1

Frequency band 5150-5250 MHz
RSS-247 Issue 2

IEEE 247-155a5 2

Mode	Channel/ Frequency (MHz)	e.i.r.p. spectral density (dBm/MHz)		Total e.i.r.p. spectral density MIMO_Chain 0+1 (dBm/MHz)	Limit (dBm/MHz)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	36 (5180)	9.970	9.037	N/A	10	Pass
	44 (5220)	9.778	8.045	N/A	10	Pass
	48 (5240)	9.883	8.303	N/A	10	Pass
IEEE 802.11n-HT20	36 (5180)	5.030	4.568	7.815	7.99	Pass
	44 (5220)	4.913	3.893	7.443	7.99	Pass
	48 (5240)	4.860	3.914	7.423	7.99	Pass
IEEE 802.11n-HT40	38 (5190)	4.145	3.900	7.035	7.99	Pass
	46 (5230)	4.156	3.766	6.976	7.99	Pass
IEEE 802.11ac-VHT20	36 (5180)	5.304	4.622	7.987	7.99	Pass
	44 (5220)	5.113	4.060	7.629	7.99	Pass
	48 (5240)	5.024	4.070	7.583	7.99	Pass
IEEE 802.11ac-VHT40	38 (5190)	4.303	4.297	7.310	7.99	Pass
	46 (5230)	4.381	4.051	7.229	7.99	Pass
IEEE 802.11ac-VHT80	42 (5210)	3.584	3.534	6.569	7.99	Pass
Remark:						
1. e.i.r.p. spectral density = Power spectral density + Duty Cycle Factor + Antenna Gain						
2. Total e.i.r.p. spectral density (Chain 0+1) = 10*log[(10 ^{Chain 0/10})+(10 ^{Chain 1/10})] + Directional gain						

Frequency band 5250-5350 MHz

Mode	Channel/ Frequency (MHz)	Power spectral density (dBm/MHz)		Total power spectral density MIMO_Chain 0+1 (dBm/MHz)	Limit (dBm/MHz)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	52 (5260)	10.655	9.021	N/A	11	Pass
	60 (5300)	10.409	8.708	N/A	11	Pass
	64 (5320)	10.780	8.720	N/A	11	Pass
IEEE 802.11n-HT20	52 (5260)	5.465	3.841	7.739	8.99	Pass
	60 (5300)	5.688	3.164	7.617	8.99	Pass
	64 (5320)	5.693	3.995	7.937	8.99	Pass
IEEE 802.11n-HT40	54 (5270)	4.893	4.237	7.588	8.99	Pass
	62 (5310)	4.733	3.721	7.267	8.99	Pass
IEEE 802.11ac-VHT20	52 (5260)	5.574	3.881	7.820	8.99	Pass
	60 (5300)	5.795	3.775	7.912	8.99	Pass
	64 (5320)	5.835	4.154	8.086	8.99	Pass
IEEE 802.11ac-VHT40	54 (5270)	5.041	4.723	7.895	8.99	Pass
	62 (5310)	4.882	4.039	7.491	8.99	Pass
IEEE 802.11ac-VHT80	58 (5290)	2.498	-1.137	4.060	8.99	Pass
Remark:						
1. Power spectral density = Conducted power spectral density + Duty Cycle Factor						
2. Total Power (Chain 0+1) = 10*log[(10 ^{Chain 0/10})+(10 ^{Chain 1/10})]						

Frequency bands 5470-5725 MHz (RSS-247 Issue 2 Not including 5600-5650 MHz)

Frequency Bands 0-70 GHz (IEEE 2.4 GHz Issues 2 Not including 6000-6000 MHz)						
Mode	Channel/ Frequency (MHz)	Power spectral density (dBm/MHz)		Total power spectral density MIMO_ Chain 0+1 (dBm/MHz)	Limit (dBm/MHz)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	100 (5500)	8.633	6.334	N/A	11	Pass
	116 (5580)	8.611	6.313	N/A	11	Pass
	140 (5700)	8.412	6.861	N/A	11	Pass
IEEE 802.11n-HT20	100 (5500)	5.717	3.665	7.821	8.99	Pass
	116 (5580)	5.348	3.634	7.585	8.99	Pass
	140 (5700)	5.514	3.660	7.695	8.99	Pass
IEEE 802.11n-HT40	102 (5510)	3.934	2.099	6.123	8.99	Pass
	110 (5550)	4.188	2.127	6.289	8.99	Pass
	134 (5670)	4.224	3.092	6.705	8.99	Pass
IEEE 802.11ac-VHT20	100 (5500)	5.695	3.808	7.863	8.99	Pass
	116 (5580)	6.083	3.912	8.142	8.99	Pass
	140 (5700)	5.783	3.849	7.933	8.99	Pass
IEEE 802.11ac-VHT40	102 (5510)	4.326	2.609	6.562	8.99	Pass
	110 (5550)	4.764	2.261	6.701	8.99	Pass
	134 (5670)	4.598	1.330	6.275	8.99	Pass
IEEE 802.11ac-VHT80	106 (5530)	-1.991	-3.001	0.544	8.99	Pass
Remark:						
1. Power spectral density = Conducted power spectral density + Duty Cycle Factor						
2. Total Power (Chain 0+1) = 10*log[(10 ^{Chain 0/10})+(10 ^{Chain 1/10})]						

Frequency band 5725-5850 MHz

Frequency Band 5.12-5.855GHz

Mode	Channel/ Frequency (MHz)	Power spectral density (dBm/MHz)		Total power spectral density MIMO_ Chain 0+1 (dBm/MHz)	Limit (dBm/500KHz)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	149 (5745)	9.953	8.082	N/A	30	Pass
	157 (5785)	10.078	8.174	N/A	30	Pass
	165 (5825)	9.574	7.756	N/A	30	Pass
IEEE 802.11n-HT20	149 (5745)	9.129	7.723	11.493	27.99	Pass
	157 (5785)	9.413	7.522	11.580	27.99	Pass
	165 (5825)	8.443	6.703	10.670	27.99	Pass
IEEE 802.11n-HT40	151 (5755)	5.904	5.207	8.580	27.99	Pass
	159 (5795)	6.209	4.921	8.623	27.99	Pass
IEEE 802.11ac- VHT20	149 (5745)	9.149	7.995	11.621	27.99	Pass
	157 (5785)	8.858	7.576	11.274	27.99	Pass
	165 (5825)	8.765	6.587	10.821	27.99	Pass
IEEE 802.11ac- VHT40	151 (5755)	6.640	5.414	9.080	27.99	Pass
	159 (5795)	6.110	5.271	8.721	27.99	Pass
IEEE 802.11ac- VHT80	155 (5775)	3.960	2.730	6.399	27.99	Pass
Remark:						
1. Power spectral density = Conducted power spectral density + Duty Cycle Factor						
2. Total Power (Chain 0+1) = $10*\log[(10^{\text{Chain 0}/10})+(10^{\text{Chain 1}/10})]$						